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JPRS 83925

19 July 1983

USSR Report

ELECTRONICS AND ELECTRICAL ENGINEERING

No. 108

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USSR REPORT

ELECTRONICS AND ELECTRICAL ENGINEERING

No. 108

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CS METHOD OF COMPENSATING DIFFRACTION DISTORTIONS IN SURFACE ACOUSTIC-WAVE
FILTERS

DASHENKOV, V. M., YUR'YEVICH, I. G. and SINITSA, V. N.

[Abstract] A major source of distortion of amplitude-frequency and phase-
frequency characteristics in surface acoustic-wave filters is secondary effects;
the effect of diffraction limits the level of out-of-band signal rejection to
-30 dB. Methods which have been suggested for correcting diffraction distor-
tions are cumbersome. A method is suggested for correcting the effect of
diffraction over a broad frequency band which does not require changing the
position of the electrodes of the opposing-post transducer, and whereby
diffraction distortions are compensated just by correction of the electrodes'
apertures. Using a model of delta sources of surface acoustic waves, structures
of the C, S and CS type represent transducers, the distribution of delta sources
in which relative to their geometrical centers has, respectively, even symmetry,
odd symmetry and the absence of symmetry. Consequently, their frequency
characteristics are respectively, real, imaginary and complex, or Hermitian.
The method suggested is applicable to equidistant asynchronous structures of
the C, S and CS types with an even and odd number of delta sources and specific
spacing. If $F_0(\omega)$ is the frequency characteristic of the structure discussed,
calculated without taking diffraction into account, the effect of diffraction
results in the fact that the characteristic takes on the form $D_0(\omega)$. The
diffraction correction, $\Delta D(\omega) = D_0(\omega) - F_0(\omega)$, is an aperiodic function
and generally complex. The problem is posed of compensating this correction
on account of an additional CS structure with the same spacing, d, and complex
characteristic $CS(\omega)$. It is required to approximate function $\Delta D(\omega)$ by
function $CS(\omega)$. Since function $CS(\omega)$ is periodic and $\Delta D(\omega)$ is aperiodic,
it is possible to do this only in a limited band. The joint effect of the
principal and auxiliary structures results in reduction of frequency distortions
in frequency band $\Delta\omega$. This is the essence of the CS method suggested for
compensating the effect of diffraction. Instead of using an additional CS
structure it is possible to change the amplitude of delta sources of the
principal structure, making them equal to to $C_k' = C_k - \Delta C_k$, where ΔC_k

represents the amplitudes of delta sources of the additional CS structure with the CS(ω) characteristics. An iteration procedure is used and the process converges, whereby the quality of the final result depends on the method of approximating the frequency characteristics of additional CS structures and the degree of diffraction distortion. A comparison is made between the effectiveness of the CS method and the method suggested by Savage et al. (1979). By the CS method practically total correction was achieved after six iterations. Figures 1; references 3 Western.
[132-8831]

PROPAGATION OF NARROW LIGHT BEAMS IN RAIN

ROGACHEVSKIY, A. G., Institute of Atmospheric Optics, Siberian Branch, USSR
Academy of Sciences

[Abstract] A Markhov approximation is used to study the propagation of a
narrow light beam through a medium containing raindrops. The mean intensity
is studied for the case in which the Markhov approximation is equivalent to
the diffraction approximation, the medium consisting of identical spherical
particles which can qualitatively describe the propagation of radiation beams
both in rain and in other dispersed media. The analysis is not limited to the
geometric optical zone of the transmitting aperture. Estimates are obtained
of the area in which the approximation of 1-time scattering can be applied.
Effective focusing in rain is considered possible. The author thanks
A. G. Borovom for statement of the problem. Figures 2; references 14:
12 Russian, 2 Western.
[222-6508]

DIFFRACTION OF WAVE BEAM ON OPEN CYLINDRICAL SCREEN

VEREMEY, V. V., SELEZNEV, D. G., Institute of Radio Physics and Electronics,
Ukrainian SSR Academy of Sciences

[Abstract] Under actual conditions a strip structure such as the many strip
structures used in antenna and waveguide technology is not struck by a planar
wave, but rather by a wave bundle. Consequently, the authors present a solu-
tion for the problem of diffraction of a wave bundle on a strip, in this case
an open cylindrical screen. The energy characteristics of the field scattered

by the reflector are practically no different from the full cross section of scattering of a planar wave over a broad range of parameters, although for narrow beams this agreement occurred only in the long wave area. Figures 3; references: 3 Russian.
[222-6508]

SCATTERING OF AMPLITUDE MODULATED WAVES ON BODIES OF COMPLEX SHAPE

SHEYNFEL'D, I. V., Scientific Research Institute of Radio Physics

[Abstract] A discussion is presented of the problem of probing bodies represented as a rigid set of sections of local reflection with amplitude-modulated waves, so that the scattering satisfies the conditions of existence of optical modulation waves for scattering on random rough-surfaced objects or volumes of turbid media. The results indicate that by using high-frequency amplitude modulated waves and detecting the low-frequency modulation waves which are scattered it should be possible to judge the scattering of long waves on objects without the use of long-wave transmitters and receivers and large antenna systems. The method can be used in optics, radar and sonar studies. Figures 4; references: 4 Russian.
[222-6508]

MEASUREMENT OF DISPERSION OF INTENSITY FLUCTUATION UPON REFLECTION OF MULTIMODE LASER BEAMS IN ATMOSPHERE

VORONOYEV, V. V., ZANDANOVA, G. I., MIRONOV, V. L., POPLAUKHIN, V. N., and TRUBACHEYEV, E. A. Natural Science Institute of Buryatsk Affiliate, Siberian Branch, USSR Academy of Sciences

[Abstract] An experimental study is presented of the relative dispersion of fluctuations of intsneity in a multimode laser beam reflected right back at the laser as a function of the turbulence along the path followed by the beam in both directions. Analysis of the experimental data indicates that the dispersion of strong fluctuations of intensity of multimode laser beams in a turbulent atmosphere depends on the diffraction parameters of the transmitter and reflector. The saturation of dispersion of narrow laser beams is greater than that of broad laser beams. The saturation of relative dispersion also depends on the type of reflector. Figure 1; references 20: 17 Russian, 3 Western.
[222-6508]

IRRADIATOR FOR ASYMMETRICAL REFLECTOR ANTENNAS WITH CIRCULAR APERTURE

TIMOFEYEVA, A. A. and YAMPOL'SKIY, V. G.

[Abstract] The results are presented of the development of an irradiator which
is a modification of a dephased horn with a break in the generatrix. The
necessary main lobe asymmetry of the radiation pattern is achieved by rotating
the axis of the strongly dephased main horn relative to the main lobe radiation
direction of the small phased horn. The peak of the main lobe is given a more
regular shape by assuring a constant phase difference in all planes passing
through the axis of the horn for all points on the edge of the main horn's
aperture. The principal shortcomings of the design--its large dimensions--is
not significant in an antenna with the irradiator separated from the reflector.
The geometric dimensions and electrical characteristics of the proposed design
are calculated. Experimental results agree well with the calculated physical
interpretation of the operation of the antenna. The design method suggested
is quite simple and allows sufficiently accurate determination of the basic
geometric dimensions of the horn as a function of the required main lobe width
and shape. Figures 6; references: 7 Russian.
[205-6508]

NUMERICAL ANALYSIS OF PRINTED-CIRCUIT SPIRAL RADIATOR AS ELEMENT OF PHASED
ANTENNA ARRAY

CHEBYSHEV, V. V..

[Abstract] The method of numerical analysis is used for evaluating the per-
formance of a printed-circuit spiral radiator in a phased antenna array. Such
a planar radiator consists of identical narrow ribbon conductors symmetrically
interleaved and out of phase, on a dielectric substrate, in an element of a
rectangular periodic structure representing a Floquet channel. The correspond-
ing integro-differential equation for the surface current density is split into
a differential one solvable in quadratures and a Fredholm integral one of the
first kind for the total current. The kernel of the latter equation contains
components of the Green tensor function reflecting the properties of a layer-
wise-homogeneous filler in the Floquet channel and satisfying the condition of
quasi-periodicity. Through application of the autoregularization principle,

this integral equation is reduced to a system of linear algebraic ones with well-conditioned matrix. Spirals with uniform curvature are considered, including equiangular and semicircular approximations of the Archimede spiral, as well as circular and linear radiators. The algorithm of calculations has been programmed in FORTRAN-Dubna for a BESM-6 high-speed computer. Numerical results are shown for a typical equiangular two-thread spiral in a square Floquet channel. Figures 4; references 5: 4 Russian, 1 Western (in translation). [215-2415]

SCATTERING OF SURFACE WAVE BY JUNCTION BETWEEN TWO DIELECTRIC WAVEGUIDES

VASIL'YEV, Ye. N., POLYNKIN, A. V. and SOLODUKHOV, V. V.

[Abstract] Two planar dielectric waveguide segments of the same material but with different thicknesses are joined through a smooth transition. The transition has an arbitrary shape, but its surface satisfies the Lyapunov conditions and conforms to the two-dimensionality of the problem. An electromagnetic surface wave propagates along one of the waveguide segments toward the junction. The coefficients of reflection and transmission as well as the fraction of power lost by radiation at the junction are calculated by numerical solution of the corresponding system of integral equations, in generalized orthogonal cylindrical coordinates, for the density of equivalent electric and magnetic currents along the lateral surface of the structure. The currents are represented as sums of a "uniform" surface current of respective propagating E or H waves and a "nonuniform" component associated with the transition. Calculations are shown for diffraction and scattering by a symmetric transition with linear taper. The results are compared with those for a direct step joint of such waveguide segments. They reveal that power transmission through the junction improves with decreasing refractive index of the waveguide dielectric. Figures 4; tables 2; references 8: 5 Russian, 3 Western (1 in translation).
[215-2415]

6

NATURAL MODES IN HEXAGONAL ARRAY OF GYROMAGNETIC WAVEGUIDES

BEY, N. A., BOGOMOLOV, A. A. and KHANDAMIROV, V. L.

[Abstract] A periodic hexagonal array of identical gyromagnetic waveguides
with circular cross section and azimuthal magnetization is considered, with
two waveguide rods along one of the ξ, τ axes and an arbitrary number of
them along the other axis. The longitudinal field components inside a wave-
guide are represented as linear combinations of solutions to "radial" differential
equations for aximuthally magnetized layers. The dispersion equation is obtained
by the method of partial regions. Solution of this equation and calculation of
the field components outside a waveguide involves evaluation of double sums in
the Hankel function of the first kind and m-th order. Direct evaluation is
possible only for slow modes (transverse wave number imaginary). Evaluation
for decaying and fast modes (transverse wave number real) requires dividing
the array into two rectangular subarrays with different periods along the x,y
axes. Numerical calculations have been made for a two-stage array of azimuthally
magnetized ferrite waveguide rods, the results revealing a dependence of the
propagation constants on the array geometry as well as on the direction and
magnitude of magnetization. The propagation constant of a synphasal mode
depends only weakly on the magnetization of rods when their radius is small
(a/λ = 0.05-0.1, λ - wavelength). The difference between the propagation
constants of a synphasal mode and an antiphasal mode increases with decreasing
rod radius and array period. The results have been checked against those for
dielectric waveguide rods in a hexagonal array and ferrite rods in a square
array. Figures 4; references: 4 Russian.
[215-2415]

DESIGN OF SLOTTED-BRIDGE PHASE SHIFTER

LOZYANOY, V. I., PROKHODA, I. G., PRUDKIY, V. P. and RYABCHIY, V. D.

[Abstract] The electrodynamic characteristics of a slotted-bridge phase
shifter are calculated by the method of intersecting straight partial ragions,
which makes it possible to determine the effect of a finite thickness of the

common wall. The corresponding diffraction problem is solved, assuming that all waveguides have ideally conducting walls and isotropic homogeneous fillers. With input and output fully matched, a fundamental mode is excited at $z = \infty$ in the $0 \leq z < \infty$, $0 < x \leq a$ region. The field components in the $d \leq x \leq d+1$, $0 \leq x \leq 2a+d$ region and in the $r \leq z < \infty$, $a+d \leq x \leq 2a+d$ region are calculated on the basis of Green's second theorem. The solution to the resulting system of integral equations of the second kind is sought in the form of a series in a complete system of orthonormalized transverse eigenfunctions. The problem reduces to an infinite system of linear algebraic equations for the coefficients of this series. It has been solved on a computer by the method of reduction. The results yield the dependence of the absolute phase shift and of the VSWR on the travel of the short-circuiting bars, at various thicknesses of the common wall. Only four modes in each regular waveguide and eight modes in the coupling region had to be considered in order to ensure fast convergence and high precision of the results. Figures 3; references 6: 5 Russian, 1 Western (in translation).
[215-2415]

UDC: 621.396.677

COMPARATIVE EVALUATION OF DESIGNS OF PHASED TRANSMITTER ANTENNA ARRAYS ON BASIS OF OPERATING EFFICIENCY

GRANOVSKAYA, R. A. and KUZ'MINA, G. A.

[Abstract] Many possible designs of phased transmitter antenna arrays are reducible to either of two basic ones, namely an array with each radiator excited through a separate active element (power amplifier) and a passive array with all radiators excited from a common source containing a signal generator and a set of power amplifiers. In another special but practical design each radiator or group of radiators is excited from an active element through a segment of a distribution system. Such an array with group excitation, consisting of $R = 2^n$ radiators in 2^i groups and $A = 2^{n-i}$ amplifiers with n feeder branches, can be regarded as an intermediate between an active one ($i = 0$) and a passive one ($i = n$). The efficiency of antenna arrays, in terms of feeder, amplifier, and exciter parameters is calculated as a funciton of i and as a function of amplifier gain. The general relations are applied to the simple example of a one-dimensional antenna array with binary power division and with a space period equal to a half-wavelength. Results obtained for arrays using waveguide feeders, particularly waveguide feeders with dielectric filler, and for arrays using microstripline feeders indicate that the former are not only much more efficient but also much less dependent on i. As i increases, however, their mass may become prohibitive. Figures 3.
[215-2415]

8

FEASIBILITY OF WIDE-ANGLE MATCHING WAVEGUIDE-TYPE RADIATORS IN PLANE PHASED ANTENNA ARRAYS

RAZDOLIN, A. M. and FILIPPOV, V. S.

[Abstract] The feasibility of wide-angle matching of a waveguide-type radiator in the design of a phased antenna array is examined by considering the effect of three waveguide components on the array characteristics. The matching device in a feeder ensures ideal matching at one position, defined by elevation angle and azimuth angle, at which the reflection coefficient is zero. Calculations for such a matching device with a rectangular waveguide located far from the radiator aperture indicate that it is possible to minimize the reflection coefficient in the H-plane, where it varies as a smooth function of the scan angle, while in the E-plane matching may become ineffective as the elevation angle exceeds 20°. The effect of a dielectric coating is best evaluated by the method of numerical optimization, inasmuch as there is no engineering method of coating design available. Calculations reveal that a coating deposited on the radiator surface only slightly improves the matching in the H-plane as the scan sector in the E-plane is decreased. An appreciably better matching at one angle or within a narrow scan sector is achieved by a coating raised above the radiator surface, just sufficiently high to avoid reflection peaks caused by resonances of the surface wave without increasing the reflection of a wave which departs from the direction of matching. A dielectric insert can serve as a matching device, as well as a protective structural component, a single-layer insert at some distance from the radiator aperture or a multilayer insert being preferable. In the case of a waveguide with dielectric filler an insert with dielectric permittivity either higher or lower than that of the filler will achieve the purpose. Figures 8; references 3: 1 Russian, 2 Western (1 in translation).
[215-2415]

ALGORITHMS OF RANDOM SEARCH FOR ADAPTATION OF ANTENNA ARRAYS WITH DISCRETE PHASE SHIFTERS

SHCHAPOV, Yu. M.

[Abstract] Adaptation of an antenna array with discrete controllable phase shifters can be achieved by the random search method, its advantages over the combinatorial search method being that the exponential increase of dimensionality

with increasing number of array elements does not present an unwieldy problem and that no estimator functions need to be constructed at intermediate points of the search tree. Various algorithms of random search have been proposed, all yielding a sufficient number of good solutions. Here a quasi-optimal two-level self-adaptive algorithm is proposed, on the basis of the Bush-Mosteller concept, with r alternative steps along the j-th coordinate forming a complete set of exclusive events. For an adaptive antenna array with many degrees of freedom, this algorithm is faster and more efficient than algorithms with local optimization such as the Gauss-Seidler algorithm, the algorithms of forward search from discretized linear phase front to maximum radiation intensity in a given direction and of reverse search with regularization, or the algorithm of blind search with equal probabilities. Figures 2; references 5: 3 Russian, 2 Western (1 in translation).
[215-2415]

IMPEDANCE AND POLARIZATION CHARACTERISTICS OF RECTANGULAR PRINTED-CIRCUIT RADIATORS IN PLANAR PHASED ANTENNA ARRAYS

FILIPPOV, V. S. and SHATOKHIN, B. V.

[Abstract] Characteristics of rectangular printed-circuit radiators in planar phased antenna arrays were studied by the method of computer simulation. The radiators were placed in the nodes of a periodic rectangular grid, each one comprising a rectangular metal plate inside a layerwise-nonhomogeneous dielectric above a plane shield and each one excited by a metal stub extension of the inner conductor of a coaxial waveguide. The frequency characteristics of the input impedance, both resistance and reactance, were calculated for this model. The array period in one of the E,H planes was varied from $0.4\lambda_0$ to $0.9\lambda_0$ (λ_0 - wavelength corresponding to center frequency f_0) in $0.1\lambda_0$ steps, with the array period in the other plane held constant at $0.6\lambda_0$. The resonance frequency and the bandwidth of the array, and thus also its input impedance, were found to be most sensitive to changes of the array period in the E-plane. Calculations of the radiation patterns in various planes revealed the existence of a cross-polarization component. Figures 3; references: 1 Russian.
[215-2415]

SUPPRESSION OF FIELD SCATTERED BY VIBRATORS OF RECEIVER ANTENNA

IL'INSKIY, A. S., PONOMAREV, L. I., BEREZHNAYA, I. V. and DOLGIY, A. V.

[Abstract] A feasibility study was made concerning suppression of the field
scattered by a radar receiver antenna. A symmetric thin vibrator or group of
vibrators in such an antenna was treated as a single one. The dependence of
its reradiation characteristics on the number and the dimensions of controllable
loads was determined for a plane electromagnetic wave incident at an arbitrary
angle. The loads were assumed to have two possible states corresponding,
respectively to zero and infinite resistance. The maximum amplitude of the
vibrator current induced by a normally incident plane wave was calculated as
function of vibrator thickness and of load width. In the case of zero load
resistance the vibrator was regarded as a continuous structure. In the case
of infinite load resistance the vibrator, effectively a short-circuited half-
wavelength structure, was regarded as being split by the load at the center
into two symmetric short ones. The results indicate that effective suppression
of the field scattered by a thin vibrator requires a number of loads which
will make the electrical length of individual vibrator segments not exceed
0.2λ. The field scattered by thick vibrators can be suppressed only by
increasing the load width h/λ between vibrator segments. Figures 3; refer-
ences 4: 3 Russian, 1 Western.
[215-2415]

COHERENT OPTICAL PROCESSOR WITH COMPLEX FORMAT OF SIGNAL RECORDING FOR TWO-
DIMENSIONAL ANTENNA ARRAYS

GRINEV, A. Yu., VORONIN, Ye. N. and TEMCHENKO, V. S.

[Abstract] A coherent optical processor with composite space modulation of
light, multichannel optical addressing, and complex format of signal recording
facilitates extraction of data on angular coordinates and frequency of an
object by a radio-optical antenna array. This is demonstrated on a two-
dimensional MxN antenna array. Signals from the array elements control the
modulator channels and are, by means of a deflector, fanned out on a carrier
consisting, for instance, of a photoconductor and an electrooptic crystal.

The processor reads an optical signal which includes the deflector sweep velocity, performs a two-dimensional Fourier transformation, and produced through an objective a space distribution of the light field which yields the desired data. The accuracy of determining the coordinates of an object with "fine and coarse" structure depends on the width of the spectrum, but can be made independent of it by proper graduation of the processor output plane. Such a processor was tested with a 4x4 antenna array and an electrooptic modulator. Figures 3; references: 3 Russian, 2 Western (1 in translation). [215-2415]

INTERLEAVED WAVEGUIDE-TYPE MULTIFREQUENCY PHASED ANTENNA ARRAY

PONOMAREV, L. I., STEPANENKO, V. I., KUL'KOV, M. yu. and KOTOV, Yu. V.

[Abstract] Interleaved multifrequency phased antenna arrays are considered in which waveguide-type radiators operating in any one frequency band lie in one plane between radiators operating in other frequency bands. The electrodynamic and power characteristics in terms of the reflection coefficient, its modulus and phase, are calculated as functions of the sweep angle in the H and $ planes. The analysis is based on the model of an infinitely long two-dimensional structure, periodic at each frequency f_q and consisting of J semiinfinitely long waveguides for each band $q= 1,2,...,Q$. The calculations are programmed in FORTRAN-4. Numerical results have been obtained for rectangular waveguides spaced in a rectangular grid of a two-frequency $(q= 1,2)$ phased array with the dimensions of a periodic element selected on the basis of an approximately 1:2 ratio of the mean frequencies of the two bands. With a periodic element including, accordingly, one low-frequency and four high-frequency radiators, the results indicate that a large fraction of high-frequency power is lost in the low-frequency radiators. This creates an additional problem in matching, namely the need to reduce the fraction of high-frequency power diverted to low-frequency radiators. Dielectric coating and solid dielectric inserts uniformly filling the waveguides have not solved the problem. Figures 4; references 5: 3 Russian, 2 Western (1 in translation). [215-2415]

USE OF MATHEMATICAL MODEL OF PHASED ANTENNA ARRAY IN MEASUREMENT OF RADIATION PATTERN

BUBNOV, G. G., NIKULIN, S. M., SERYAKOV, Yu. N. and FURSOV, S. A.

[Abstract] Measurement of the radiation pattern of a phased antenna array can
be more effective if additional reliable a priori information about the array
geometry is known. This approach is examined here from the standpoint of
data accuracy and reproducibility. As a specific example a periodic MxN array
is considered with identical radiators and discrete phase shifters for L
positions, its mathematical model based on the assumption that the excitation
amplitude at any one radiator does not depend on the positions of the phase
shifters of all other radiators. The excitation amplitude is indirectly
determined from measurement of the field intensity in the near zone with the
phasing vector F known. This can be done either by moving the probe relative
to the antenna and scanning the field distribution (radiation pattern) with a
collimator at all L phasings, or by measuring the field with a stationary probe
through switching or modulation at $F \geq MNL$ different phasings. In both cases
the error of the model and the accuracy of radiation pattern measurement can
be evaluated, the second method being preferable. An analysis based on micro-
wave circuit theory is most appropriate here, the amplitude of incident waves
being calculated from the corresponding Kirchhoff equation. An antenna array
is represented as a chain of three multipole noetworks: zMN-pole collector
stage with scattering matrix Q, 2MN-pole radiator stage with scattering matrix
P, and 4MN-pole phase-shifter stage with a partitioned diagonal scattering
matrix which depends on the phasing F. The procedure is demonstrated on a
typical straight-through array of 16 elements with $\| P \| \approx \| Q \|$ and with the
transmission matrix the same from the radiator side as from the collector side.
Figures 1; references 7: 6 Russian, 1 Western.
[215-2415]

EFFICIENCY OF ORIENTED TRIORTHOGONAL ANTENNA ARRAY FOR POLARIZATIONAL SIGNAL PROCESSING UNDER CONDITIONS OF REFLECTION BY GROUND SURFACE

DIDENKO, Yu. I. and NIKITCHENKO, V. V.

[Abstract] Polarizational processing of radio signals is considered, by a
method which combines polarizational elimination with polarizational matching.
For this purpose the oriented triorthogonal antenna array consists of three

mutually orthogonal electric vibrators, one of them oriented with its electric axis in the direction of the incoming signal. That axis is assumed to be horizontal, without detracting from the generality of the analysis, and specular reflection by a horizontal electrically homogeneous surface is taken into account so that both a direct signal and a reflected signal appear at the receiver. Processing of signals includes weighting the complex emfs at the antenna outputs, with the noise level assumed to be the same at all outputs, so that slow fluctuations of polarization parameters can be disregarded. Numerical calculations for a dielectric surface (fresh water with dielectric constant ε = 80 and electrical conductivity o = 0.001 S/m) and a phaser of the direct wave with a modulus ranging from 0.1 to 10 indicate that, over a wide range of sliding angles, this method yields a higher energy gain than an antenna with fixed polarization. The polarization phaser can be controlled depending on the sliding angle. Figures 2; references 9: 6 Russian, 3 Western (1 in translation).
[215-2415]

CALCULATION OF TEMPERATURE-FREQUENCY CHARACTERISTICS OF FILM HEATED CRYSTAL
RESONATORS

MAR'YANOVSKIY, L. S.

[Abstract] A method is presented for thermal design of crystal resonators
using constant heating of the crystal alone. This technique greatly reduces
the volume and parts count of the thermostated equipment, greatly improving
reliability and decreasing costs. The heater characteristics and power con-
sumption are calculated and the temperature instability component of crystal
oscillator frequency is determined. The accuracy of calculation of the
temperature-frequency characteristics of a resonator achieved by the method
suggested is sufficient for engineering design purposes. The difference in
temperature-frequency characteristics obtained experimentally and by calculation
is significantly less than the frequency instability of the unheated resonator.
This indicates that slight variations in resonator operating conditions will
not cause significant variations in the temperature-frequency characteristics.
Figures 2; references: 3 Russian.
[205-6508]

DISTRIBUTION OF LENGTH OF MAXIMUM COMPRESSED BROADCAST SIGNAL LEVELS

BARKOVA, N. A. and GLUKHOV, A. A.

[Abstract] The distribution of broadcast signal level lengths was studied at
the output of an intercity broadcast link and at the output of an AB 2/3 channel
forming compressor with constant signal averaging time in the analyzer and
excess time in 7 intervals from 0.5 to 300 s with threshold level values of
0 dB, -3 and -6 dB, and the error in maintaining established level diagram not

over ±1.0 dB by parallel signal analysis. The univariate distribution function of mathematical expectation, mean number of excursions above the fixed levels in each time interval and mean total time of excursions above the fixed levels were calculated. Brief excursions not over 0.5 to 1.0 s in length above the -3 and -6 dB levels were most probable for all broadcast signal types. Music broadcasts most frequently exceeded the levels, speech broadcasts less frequently. The probability of exceeding the -6, -3 and 0 dB levels for 1.0 s or more during the course of a day was found to be 46.0, 35.3 and near 0%. Figure 1; tables 2; references: 3 Russian.
[205-6508]

COMPARATIVE ANALYSIS OF NOISE TOLERANCE OF METHODS OF PROCESSING FREQUENCY-SHIFT-KEYED SIGNALS WITH SPLIT FREQUENCIES AGAINST NOISE

YESIPENKO, V. I., Scientific Research Institute of Radio Physics

[Abstract] A frequency-shift-keyed signal with split-frequency values is a signal type not previously studied. In order to determine the most promising method of processing such a signal, this work performs a comparative analysis of the noise tolerance of two processing methods: wideband reception with integration after the detector, and wideband reception with nonlinear noninformational transformation and narrow band filtration before the detector. The probabilistic criterion used in the work is the most objective criterion for evaluating the quality of electronic devices, because it eliminates the possibility of subjective considerations frequently observed when the signal-to-noise ratio is used. The error probability is determined for the second, preferred method of detection. Figures 5; references: 22 Russian.
[222-6508]

BROADCAST SIGNAL ELEMENT RECOGNITION

IL'ICHEV, V. P.

[Abstract] Speech and music signals must be processed differently when broadcast. Consequently, an adaptive broadcast signal converter must recognize the difference between speech and music signals. Envelopes of speech and music signals showing amplitude as a function of frequency illustrate the differences

between the two signal types. By clipping both speech and music signals and selecting the center of the amplitude range, the signals can be converted to trains of pulses which are much shorter for speech than for music. A structural diagram of a signal element recognition device which employs this pulse length difference to recognize speech and music signals is presented. The device can recognize a music signal within 2.5 seconds and speech within 1 second with a recognition error of not over 1%. Figures 4; references 4: 3 Russian, 1 Western.
[205-6508]

EFFECTIVENESS OF PARTIAL DISTORTION NEUTRALIZATION METHODS FOR DIGITAL AUDIO BROADCAST SIGNAL TRANSMISSION

BALAN, N. M., VYKHODETS, A. V., DENISOV, V. I., KOROL'KOV, V. V. and RABINOVICH, G. V.

[Abstract] An estimate is made of the effectiveness of three methods of partial neutralization of the influence of pulse cook modulation signal dropouts on the quality of speech transmission. The three methods differ in the complexity of their technical implementation in a system with nonlinear coding. The methods are based on erasure of a signal which differs too greatly from its immediate surrounding signals, extrapolation of neighboring signals to reconstruct a signal differing too greatly from its neighbors and replacement of distorted signal readings by extrapolation based on the two previous readings. The hardware system used in the study allowed modeling of dropouts in the form of inversion of any desired bit in any frame of the pulse code modulated signal process. Speech quality was found to vary with duration and frequency of distortions. With distortion bursts 0.47 to 7.5 ms in length, the third method was more effective than the first two in partial neutralization of distortions. With distortion bursts over 0.75 ms in length, the method of erasure of distorted frames was most effective. The zero-order extrapolation method (method 2) was intermediate in both cases in its signal restoration capacity. Figures 7; references 5: 1 Russian, 4 Western (1 in translation).
[205-6508]

DESIGN OF MW ANTENNAS FOR COMBINED TELEVISION TRANSMITTER STATIONS

TARAVKOV, A. N.

[Abstract] The physical and mechanical design of MW antennas for combined radiation of MW and television signals is discussed. Free standing tower antennas and antennas with grounded guys up to 350 m in height are discussed. In each case the design of the antenna must be selected on the basis of the required support height, broadcast wavelength and radiation pattern, as well as the territory to be covered and the presence of other structures in the vicinity of the antenna. Radiation patterns of single and double sloping beam antennas are illustrated on polar graphs. These two antenna types achieve efficiencies of at least 70%. Feeder lines used for MW transmitter antennas are described. Figures 10; references: 3 Russian.
[205-6508]

CONSTRUCTION OF MICROPROCESSOR REMOTE GAMES TRAINERS AND CODING OF VISUAL INFORMATION IN THEM

BARANOV, A. I., VASIL'YEV, V. V. and DANILYAK, S. N.

[Abstract] A remote games trainer is an electronic device which can simulate various game situations on a monochrome or color television receiver. This article studies the hardware required to create microprocessor games television trainers and automata and suggests a method for coding visual information for such devices. The method suggested allows preliminary coding of background information which is inserted in a PROM and mapped to the television screen by means of a video interface. The video interface can also synthesize square-wave sound. The use of a microprocessor controlled television games trainer yields good results in terms of producing complex television images, increasing the game difficulty and control flexibility, and reducing the time required to design such devices. Figures 3; references 10: 2 Russian, 8 Western.
[219-6508]

OPTIMAL DISCRETIZATION OF MOVING IMAGES

BORODYANSKIY, A. A.

[Abstract] A study is made of the possibility of optimal discretization of moving images for digital television transmission. The work is made pressing by the need to reduce the bit rate of digital television transmission to 34 Mbps, consistent with the channel transmission capacity of the unified automatic communications system of the USSR. Estimates obtained in the work indicate that the use of practically achievable three-dimensional filter apparatus for three-dimensional discretization and restoration can achieve something less than 6 times signal spectrum compression. Figures 6; references: 5 Russian.
[205-6508]

FACTORS ON WHICH EFFECTIVE REDESIGN OF CABLE COMMUNICATION LINES

FARBER, Yu. D., candidate of technical sciences, chief of laboratory, All-Union State Trust for Construction of Long-Distance Wire Communications Structures (Mezhgersvyaz'stroy)

[Abstract] Redesign and replacement of existing interurban cable communication lines are necessary in order to keep up with growing demand as well as with progress in the state of the art. A program is usually planned on the basis of projections covering a period of 15-20 years ahead. Factors which determine the effectiveness of a redesign and replacement program are both economic and technical. The cost of change-over will be reduced by: 1) Shortening the distance between successive feed points; 2) Utilization of existing structures which contain attended repeater stations; 3) Segmentization of lines for full utilization of all existing unattended repeater stations with a minimum of additional ones; 4) Minimizing the number of replacements; and 5) Minimizing the necessary service disruptions. The last two requirements are best met by a replacement technology which provides ahead for future additions. The main technical factor to be considered is attenuation, which limits the useful frequency range and the number of available frequency channels. The combination of these factors determines the length of new line segments between repeater stations as well as the types and the sizes of cables to be installed. A typical illustration is the changeover, now in progress, from K-1920 to K-3600 trunk lines with appropriate repeater, terminal, and radio relaying equipment. Figures 2.
[183-2415]

DEVICE FOR DETERMINING ROUTE OF UNDERGROUND CABLE

MASHKIN, F. Z., communication systems electrician, city of Chkalovsk, TaSSR

[Abstract] A cable finder has been developed by the author for tracking a cable route without interruption of service and without heavy interference which the oscillator of an IPL-4 or IP-7 instrument causes. The device is not only simple and inexpensive but also safe and requires only one operator using both hands. It consists of two elbows and two handles with a plug gage inside each, all made of steel. As the operator moves away from a cable, the needles of both indicators deflect so as to point in the direction of the cable. When the needle of only one indicator deflects, this means the cable bends at the particular location. When the needle returns to its original position, this means the cable bent in a loop (cable box). The handles must not touch. Figures 4.
[183-2415]

CIRCUITS AND SYSTEMS

ESTIMATE AND REDUCTION OF INFLUENCE OF DIFFRACTION OF SURFACE ACOUSTIC WAVES
ON CHARACTERISTICS OF FREQUENCY FILTERS

NELIN, Ye. A. and GRANKIN, I. M.

[Abstract] Diffraction of surface acoustic waves results in an increase in the
level of side lobes in frequency filters. Methods previously suggested for
compensating diffraction distortion by correcting the weight factors of the
electrodes in an apodized transducer (amplitude correction) and their positions
(phase correction) have a number of limitations. A discussion is presented of
the influence of diffraction of surface acoustic waves on the level of side
lobes of the amplitude-frequency characteristics of filters with transducers
which have various structures. It is shown that rejection of side lobes by a
transducer apodized according to a function of the sinc x type is considerably
worsened by diffraction distortion. Diffraction has a lesser influence if the
transducer is apodized in keeping with a Hamming function. A relatively simple
and sufficiently effective method is suggested for reducing the influence of
diffraction of surface acoustic waves on the characteristics of a filter whose
apodized output transducer is placed in the close vicinity of its non-apodized
input transducer. Experimental and ideal amplitude profiles of the beam of
the surface acoustic wave radiated by the non-apodized transducer are presented.
Experimental profiles were produced by optical exploration of the surface of
the ST-cut quartz substrate. It is seen that at the boundaries of the beam
defined by the aperture of the transducer, the amplitude of the surface acoustic
wave is approximately two times lower than in the central part. As the radiating
transducer is neared, the central part of the beam becomes more uniform and the
curvature of the profile in transition regions increases, but the amplitude of
the surface acoustic wave is reduced, as previously, at the edges of the beam
and the amplitude of overshoots between the central part and transition regions
increases. Consequently, the greatest amplitude distortions take place in
transition regions of the beam in the near region. Phase distortions are also
maximum in transition regions. Diffraction distortions are reduced in this
case by increasing the aperture of the non-apodized transducer, which results
in elimination of the integration of transition regions by electrodes of the
apodized transducer. The ratio of the apertures of the apodized and non-apodized

transducers should be 0.7 to 0.8. An evaluation is made of the effectiveness of this method. An equation is given for the amplitude, U, of the signal received by an electrode of the apodized transducer from an electrode of the non-apodized when the surface acoustic wave is propagated from left to right. When the equation $U \approx 2Y(1 - j)$ is fulfilled, where Y is the normalized weight factor of the electrode of the apodized transducer, distortions of amplitude and phase as the result of diffraction are absent. It is shown that with a ratio of the apertures of the apodized and non-apodized transducers of 0.7, with a diffraction parameter of $r \leq 0.1$ the method suggested is more effective than the correction of weight factors. The effectiveness of the method is increased as the diffraction parameter is reduced. Figures 4; references 9: 3 Russian, 6 Western.
[132-8831]

LINEAR INTEGRATED ATTENUATORS WITH PROGRAM CONTROL

SIKOLENKO, S. F.

[Abstract] Controlled linear attenuators in the form of a resistance matrix and multichannel switch integrated circuit switched by a digital code are widely used in designing amplifiers with programmable gain. Hitherto there has been no analysis of the influence of the control code on the parameters of the matrix used as the attenuator, and therefore it has been been possible to control effectively the amplifier's gain. A study is made of the capabilities of integrated matrixes included among series 310 and 301 integrated circuits, employing $R_i = R_0 2^{i-1}$ and R-2R resistance networks. It is necessary to ensure maximum values of the gain and regulation range, as well as directivity of the change in the combination of gain factors, K_{pi}, whereby the quantization step for the gain is not to change sign over the regulation range. A comparative evaluation is made of the parameters of linear controlled attenuators, which demonstrates that the highest effectiveness in controlling the gain can be arrived at in an attenuator employing a matrix with an R-2R resistance network which has a binary control code. The minimum value of the quantization step for the gain of a controlled attenuator employing an R-2R network is limited by the relative error in manufacture of the resistors, which can equal ± 0.0135 percent, taking into account the resistance of the MIS (metal-insulator semiconductor) switch. The parameters of attenuators employing an R-2R resistance network depend to a great extent on the code for controlling the switches. Controlled attenuators with two-position and single-position switches are discussed. A summary is given of formulas for determining the electrical parameters of linear controlled attenuators. Figures 2; tables 2; references: 5 Russian.
[132-8831]

MICROPROCESSOR-BASED DIGITAL FILTERS USING 'DISTRIBUTED ARITHMETIC'

SOTNIKOV, A. D.

[Abstract] Existing microprocessor digital filters using "distributed arithmetic" operate by storing precomputed values in ROM. Then, as the digital data stream is processed, the microprocessors simply address the appropriate ROM locations and extract the precomputed values for instantaneous signal levels rather than attempting to calculate rapidly changing signal levels in real time. This article analyzes an algorithm which achieves the same result without requiring the use of supplementary registers. The method allows microprocessors to be used to construct high order (N >20) nonrecursive digital filters used to process signals with sampling frequencies of 80-120 KHz. The digital filters thus designed can be used in transmission systems as individual and group filters and in PCM matching devices with time and frequency separation of channels. Figures 2; tables 3; references 7: 2 Russian, 5 Western.
[205-6508]

USE OF WALSH TRANSFORM TO SOLVE SYSTEMS OF LINEAR DIFFERENTIAL EQUATIONS WITH VARIABLE COEFFICIENTS

KALNIBOLOTSKIY, Yu. M., SOLODOVNIK, A. I. and BONDARENKO, V. N.

[Abstract] A study is made of the solution of systems of linear differential equations with variable coefficients such as those obtained in an analysis of electronic circuits, studied by methods based on the Laplace and Fourier transforms, T transforms, etc. This article utilizes an approach which consists essentially of the application of a Walsh transform, producing a piecewise-constant approximation of the solution of the initial system of differential equations. This approach is distinguished by the simplicity of mutual mapping of the time area and Walsh transform area. The same fast Walsh transform algorithm can be used to perform direct and inverse transform. Formation and inversion of the matrix of linear algebraic equation system coefficients in each subinterval can be performed independently of the other subintervals, the relationship between subintervals being determined by one coefficients of the Walsh series. This means it is possible to perform parallel-sequential solution of the system of linear differential equations with variable coefficients. References 8: 5 Russian, 3 Western.
[219-6508]

NUMERICAL RESULTS OF MODELING MICROSTRIP ELEMENTS AND MICROWAVE INTEGRATED
CIRCUIT ELEMENTS

TOZONI, O. V. and VASIL'YEV, V. Ye.

[Abstract] The results are presented from a calculation of the integral
parameters and characteristics of microstrip elements by means of a new
system of programs involving reduction of the integral equations to a system
of linear algebraic equations for the unknown values of longitudinal currents
in a sequence of discrete cross sections along the strips. All calculations
were performed by the same algorithm in the universal program system which
runs on a BESM-6 computer. One point on the characteristic requires 1 to 2
minutes of machine time, irregularities require 3 to 4 minutes, and a functional
microstrip element with a configuration of moderate complexity (7 to 10
branches) requires 5 to 7 minutes of machine time. The large expenditures of
machine time result from the fact that the integral parameters of the micro-
strip elements are determined after solution of the entire electrodynamic
problem, i.e., determination of current distribution along the entire branch
of the element. Figures 8; references 19: 8 Russian, 11 Western.
[219-6508]

METHOD OF DESIGNING ADJUSTABLE NON-MINIMUM-PHASE CORRECTORS

KISEL', V. A. and RYZHOV, V. A.

[Abstract] A method is suggested for designing adjustable amplitude-phase
correctors based on standard components of band-pass filters and adders.
Circuits with adjustable characteristics are usually synthesized by means of
analog computer methods. The method suggested makes it possible to produce
designs which differ advantageously from these circuits. The circuit described
contains: 1) Two adders; 2) Frequency-dependent 4-terminal network with a
transfer function of K(p); 3) Adjustable attenuator, ; and 4) 4-terminal
networks with frequency-independent transfer functions, A and B. The circuit's
transfer constant is $T(p) = \{K(p)[\mu (B-1) + A] \pm 1\} // [1 \pm K(p)\mu]$. An
equation is given for the transfer function when a band filter with transfer
function K(p) is used as the frequency-dependent 4-terminal network. Expressions
are found for the phase-frequency characteristic and the group transmission
time characteristic, $t_{gr}(\omega)$. It is shown that this circuit makes it possible

to adjust $t_{gr}(\omega)$ over a wide range by varying the parameters of the attenuator, μ. By changing the sign of μ it is possible to produce higher figures of merit for the phase corrector than for the band filter. A circuit diagram is give of a phase circuit with a low-figureof-merit band filter in which the opportunity is provided for tuning the central frequency. By means of a potentiometer and variable resistor it is possible to adjust independently the value of $t_{gr\ max}$ and the central frequency. It is shown that if as the band component a design is employed which makes it possible to tune the central frequency without changing the relative bandwidth, then the possibility appears in the phase corrector of moving the peak of the group transmission time characteristic along the frequency scale without changing the value of this peak. Figures 3; references 3: 1 Russian, 2 Western.
[132-8831]

DETERMINING OPTIMAL TOLERANCES FOR LINEAR INTEGRATED CIRCUIT ELEMENT PARAMETERS

KOVAL', V. A.

[Abstract] A formalization and solution are suggested for the problem of optimal calculation of the parameters and tolerances by multiple-criterion optimization during consideration of the statistical characteristics of elements. The solution is intended to be used in the integrated circuit industry. The parameters to be optimized and areas of search for the necessary solutions and form of criterial functions are formulated. The search for optimal values of parameters and tolerances is performed as a multistage optimization task, approached in two ways. The first approach involves searching for the area of assignment of tolerances in the area of possible solutions, followed by a search for the parameter optimization problem in the area of permissible solutions. The second approach is a combined problem of nonlinear optimization, an iterational process of determining the values of parameters and tolerances without using multistage solutions. It is formulated as a problem of multicriterion and multiparameter nonlinear optimization. The method of joint optimization is found to produce better results. Figures 1; tables 2; references 3: 1 Russian, 2 Western.
[219-6508]

STATISTICAL MODELS OF CIRCUIT FOR SUMMATION OF POWERS OF TRAVELING-WAVE TUBE AMPLIFIERS

KATS, A. M., KLINAYEV, Yu. V. and GLEYZER, V. V.

[Abstract] Quantity-produced traveling-wave tubes have variations in phases and amplitudes of the output signal which are determined by the level of the technology and the design of the device. Consequently, a statistical estimate of quality criteria is necessary for a detailed study of the effectiveness of circuits for parallel summation of the powers of traveling-wave tubes in output stages. Several radio engineering systems utilize several identical traveling-wave tubes as amplifiers whose powers are summed in order to operate on a common load. A statistical confidence model is developed and a study is made of its characteristics for a circuit which summs the powers of ideally matched traveling-wave tube amplifiers connected in parallel to a common load. The statistical model is constructed on the basis of a probabilistic treatment of the root gain-bandwidth product of summation of powers for traveling-wave tubes. A probability density function is constructed for this product. An expression is derived for the characteristic function of the summation co-efficient. A probability density function representing a beta distribution of the first kind for the root gain-bandwidth product is used as the statistical confidence model of the summation dircuit. It is shown that the distribution function of the root gain-bandwidth product of the summation circuit is asymptotically normal both in terms of phase variance of the output signal of the summing devices and in terms of their number. The relationships arrived at make it possible to calculate the principal output characteristics of the effectiveness of power summation circuits and the parameters of their repro-ducibility. A summation circuit employing transparent traveling-wave tubes is reproducible both in terms of high values of the mean root gain-bandwidth product and in terms of the high percentage of the yield of circuits with this product close to one. This type of circuit is therefore preferable to non-transparent analogues. The variance of root gain-bandwidth products is reduced drastically with an increase in the number of devices in the circuit. A highly efficient and reproducible summation circuit can be produced by combining parallel connection of devices with average power with an output stage utilizing a transparent traveling-wave tube with these two sections then connected in parallel. Figures 5; references 7: 5 Russian, 2 Western in translation. [132-8831]

PULSE SIGNAL DETECTION IN SYSTEMS HAVING PHOTODETECTORS WITH TIME LAG IN PRESENCE OF CHANGING BACKGROUND ILLUMINATION

VOLKOV, O. A. and LEBED'KO, Ye. G.

[Abstract] The time constant of the photodetecting circuit must be taken into account in systems for receiving pulsed optical signals which employ photodiodes. With a changing background exposure, the spectral density of the photodetector noise and the transfer function are functions of the incident background radiative flux, because of the change in the average value of the photodiode current and the p-n junction capacitance. Optimal filtration is impossible under these conditions because of technical considerations. This paper analyzes the change in the signal-to-noise ratio using the example of optimal detection conditions, assuming gaussian statistics for the pulse noise so as to have a standard of comparison for nonoptimal filtration cases. Two analytical expressions are adduced for the signal-to-noise ratio in the case of an inertialless photodetector, neglecting amplifier noise, both in the presence and absence of background illumination. Under actual conditions where nonoptimal or quasi-optimal filters must be used, the choice of an efficient bandwidth depends on the background level. At low background levels, it is efficient to use filters with a narrow bandwidth; at higher levels, filters having a wider bandwidth should be used. An expression is also given for the average relative signal-to-noise ratio of an inertialless photodetector for a fixed bandwidth, where the readiative background flux is a random quantity with a known probability density. The choice of the transmittance bandwidth in this case is made based on a maximum of this signal-to-noise ratio as the bandwidth is varied. Figures 2; references: 4 Russian. [93-8225]

ANALYSIS OF EFFECTIVENESS OF AUTOMATIC NOISE REJECTER WITH CORRELATION FEEDBACK IN TERMS OF REJECTION FACTOR

LIKHAREV, V. A. and PANOV, V. M.

[Abstract] For the purpose of rejecting passive noise, i.e., echoes from extensive local objects which occupy several range resolution elements, algorithms have been proposed which utilize correlation feedback, and it has been demonstrated that devices which operate according to these algorithms make

possible minimum noise power in their output. A structural diagram is given of an automatic rejecter for passive noise utilizing correlation feedback. The circuit consists of a delay line for a delay for the repetition period of the transmitted pulses, into whose input enter complex samples, $X_{i,j}$, caused by reflection from the i-th range resolution element in the j-th transmission; and of a weight factor multiplier and a subtracter. Adaptation in the form of adjustment of the weight factor is accomplished by means of a feedback loop consisting of a complex conjugation unit, multipliers, and a counter-type adder. The quality indicators of an automatic rejecter of this sort are determined to a great extent by the adaptation coefficient, γ, which in practice is assumed to be constant for each step and is selected so that $0 < \gamma << 1/\sigma^2$, where σ^2 is the noise poser in the unit's input. Formulas are given which express the rejecter's functioning algorithm. An expression is arrived at for the weight factor of the rejecter at the (i − 1)-th adaptation step. An expression is given for the mean noise power in the automatic rejecter's output. It is demonstrated that the region of convergence of the algorithm of an automatic rejecter with correlation feedback lies in the range of $0 < \gamma < 1/\sigma^2$ and depends only on the noise power. An analytical expression is found for the steady value of the rejecter's rejection factor. The relationship is illustrated, between the steady rejection factor and the normalized adaptation factor, where the interperiod correlation factor equals 0.99. It is shown that the steady rejection factor of an automatic rejecter with correlation feedback is reduced with an increase in the normalized adaptation factor. Figures 2; tables 2; references: 3 Russian.
[132-8831]

CONTROL OF PARAMETERS OF SECTIONS OF COUPLED TRANSMISSION LINES WITH LUMPED
CONTROLLING DISCONTINUITIES

VOROB'YEV, P. A.

[Abstract] Sections of coupled striplines with lumped controlling discontinuities
are used as controllable phase delay lines which under specific conditions
have a linear dependence of the phase shift on frequency. Calculations are
presented, of the wave impedance and phase constant of sections of coupled
striplines with the imposition of constraints on the length of the lines and
asymmetry of the structure and control range of discontinuities. Formulas,
suited for practical applications, are arrived at for the input impedances
of an infinite chain of identical sections with limiting values of Z, repre-
senting the controlling discontinuity. With Z = 0, the chain degenerates into
a cascade connection of rejection filters connected in opposing fashion, whereby
each section contains two such filters. With specific limitations, the chain
can be substituted by a regular transmission line, called an E-line, with
equivalent linear parameters. In a multilayer stripline consisting of sections
of coupled striplines, the effect is observed of redistribution of the power
flux of the traveling T-wave among the linear dielectric media with a change
in the parameters of discontinuities. In sections with a dielectric which is
discontinuous in cross section, this results in modulation of the speed of the
traveling wave. The conditions are found under which a chain of coupled strip-
lines is equivalent to a stripline waveguide. The results are given of calcula-
tion on a computer of a section with non-identical permittivities of layers
under specific conditions. The results are given of a numerical calculation
of matrixes of capacitance and inductance factors for coupled striplines.
Calculated and experimental curves are given, expressing the relationship
between frequency and attenuation factors and the difference phase shift.
Results are presented for the 0 to 0.4 GHz frequency band. Figures 3; refer-
ences: 9 Russian.
[132-8831]

DISCRETE HILBERT TRANSFORMER AS DEVICE FOR PROCESSING SINGLE-SIDEBAND SIGNALS

PETROV, V. K. and TIKHVINSKIY, V. O.

[Abstract] An algorithm is presented which makes it possible to process
single-sideband signals in receivers with digital heterodyning. An amplitude-
modulated single-sideband signal is an analytical signal, because the logarithm
of the envelope and instantaneous values of the phase form a pair of Hilbert
transforms. A single-sideband signal is expressed analytically as $s(t)$ =
$x(t) + j\hat{x}(t)$ = $\left|s(t)\right|$ exp exp [$j\Phi(t)$], where $x(t)$ is the original signal
and $x(t)$ is the Hilbert transform of $\hat{x}(t)$. Expressions are given for the
spectra of these two signals and it is shown that the Hilbert transform can
be represented as the passage of signal $x(t)$ thrugh a system having specific
frequency and pulse characteristics. Expressions are found for the envelope
and phase for the case of limitations for minimum-phase signals. For
minimum-phase signals the logarithm of the envelope and the phase represents
a pair of Hilbert transforms. An algorithm is presented for a demodulator
which can operate upon condition that the maximum value of the signal is less
than the amplitude of the oscillation carrier. In receivers with digital
heterodyning, an analog-digital converter quantizes the signal after it has
passed through the digital receiver's preselector. The quantized signal has
a spectrum representing a multiply transformed spectrum of the original
oscillation. The sequence of quantized values of the signal enters a digital
filter and then a demodulator. Complex sequences are discussed in which the
real and imaginary parts are related by relationships resembling Hilbert trans-
forms. It is demonstrated that for discrete sequences in which the condition
of minimality of the phase is fulfilled the logarithm of the value of the
amplitude is related to the phase by means of a discrete Hilbert transform.
By calculating the tuning factors for digital filters it is possible to arrive
at values of these factors for the required Hilbert transform. Figures 1;
references 5: 3 Russian, 2 Western (1 in translation).
[132-8831]

ANALYSIS OF ESTIMATE OF STRENGTH OF NOISE SIGNAL BY MEANS OF DIGITAL MODEL

VASENKOVA, L. V., GORBACHEV, A. A. and DANILOV, V. I.

[Abstract] Impulse noise is the most widespread in the reception of noise
signals in the VHF and UHF bands. A priori insufficiency of information on

the distributions of noise hampers the use of parametric methods of estimating the parameters of noise signals. The problem of receiving signals against a background of noise is complicated by the fact that usually the intrinsic noise of the radiometer is stronger than the legitimate noise signal. The bias of the estimate of the signal strength can be reduced considerably by employing the slight dependence on the strength of the pulse component of the sampling mean first-order statistics in sampling from the envelope the mixture of noise and interference. By employing a digital model utilizing a BESM-6 computer, a study is made of the properties of a procedure combining the advantages of a traditional radiometer in the absence of noise in its input with the advantages of estimating the signal strength by means of first-order statistics in the presence of noise. The apparatus used consists of two smoothing filters, a unit for recording minimum values, two attenuators, two switches and a computing device. The input process is modeled by a sequence of 10,000 squares of pseudorandom values of Rayleigh and Rice distributions, with the strength of the noise component equal to 1, the amplitude of the interference equal to 0 to 10, the mean relative pulse duration equal to 10, and the pulse duration equal to 12 units. The signal strength is determined by one of two channels and the channels are switched by means of a switch. The main channel consisting of the unit's input, the first smoothing filter, a switch and the unit's output, is used for measurements if the computing device decides that interference is absent in the unit's input, and this decision is determined by the ratio of instantaneous values of the signal and of the threshold level in the computing device's inputs. The threshold level is formed in the reference channel, consisting of the unit's input, the first smoothing filter, the unit for recording minimum values, the other switch, and the other smoothing filter. The threshold level is formed during the entire measurement period and it is used for the purpose of extrapolating the signal at time intervals occupied by interference. Curves are shown, expressing the relationship between the bias of the estimate of the strength of the noise signal and its standard deviation, and the amplitude of the interference and the smoothing parameter, and the relationships between the expectations of values in the outputs of the two smoothing filters in the absence of inter-ference. These curves are compared with the analogous curves for estimating the noise signal strength by means of first-order statistics. Comparison of the static characteristics of estimates according to the algorithm described and by means of first-order statistics shows distinct advantages of the former, both in terms of bias and variance. The bias of the estimate is reduced with lowering of the threshold level, but the variance of the estimate increases. Generally, the bias will be determined by the distribution of probability densities of the amplitude of the interference and can turn out to be comparable to the standard deviation of the estimate. Figures 2; references: 3 Russian. [132-8831]

OPTIMAL ORGANIZATION OF GROUP LINE TRANSITS IN COMPUTERIZED NETWORK NODES

SERGEYEVA, T. P.

[Abstract] Practical optimization of communications networks requires the development of a heuristic optimization algorithm, a significant and complex task. This article outlines methods for optimizing the gathering of transit channels into group channels at a network node as a function of the changing traffic load at the node and the available channels and transceivers. The solution obtained is always a compromise between optimal arrangement of group channels and minimization of the number of physical rewiring operations which must be performed to reduce costs. The algorithm presented can generate recommendations for channel regrouping at any network node and at neighboring nodes so as to maximize the order of transit grup channels. With slight changes the algorithm can be used to increase the order of transits in all nodes of a network fragment. Figures 4; tables 1; references: 2 Russian. [205-6508]

MARKOV MODEL OF RESETTABLE RADIOELECTRONIC EQUIPMENT

MARTYNENKO, O. N.

[Abstract] A study is made of the behavior of radio electronics equipment which functions according to the following chain of events: malfunction, failure, search for trouble, reset; with this chain repeated indefinitely. A Markov model of this equipment is constructed with the following assumptions: That the equipment can be divided into m functional elements and at any moment of time t can be in one of m + 1 states of finite phase space S. State 0 is the state of good working order and the remaining m states correspond to failure of any one element. The functioning of the unit is described by the Markov random process ξ (t), t $\geq$ 0. The time of failure and the time for resetting elements are exponentially distributed with individual constants of λ_i and μ_i, where i = 1, m. Transitions are allowed only between the 0-th and i-th states. The probability of simultaneous events over an infinite time range equals zero. Expenditures for resetting the equipment are assumed to be negative gains and matrix A, representing an infinitesimal matrix of Markov process ξ (t), is put in correspondence with the matrix of gains, R. It is further assumed that at moments of failure the equipment can undertake actions

which will influence the further probability characteristics of the process and gains which can be made. In each state the elements of matrixes A and R will depend on the control selected. A model is constructed in the form of M = {S, D, A, R, T}, where D is the finite space of controls and T is the time during which functioning of the equipment is considered. The complete anticipated gains of model M at moment of time t are found from a system of linear differential equations. Model M makes it possible to solve a number of problems relating to reliability and technical diagnosis of radio electronics equipment and is convenient for use on a computer. References 3: 2 Russian, 1 Western in translation.
[132-8831]

EFFECTIVENESS OF DISCRETE REGULATION OF RADIATED POWER OF TRANSMITTER

POSTYUSHKOV, V. P. and CHUKHVANTSEV, V. Ya.

[Abstract] The problem is discussed of estimating the effectiveness of discrete regulation of the power of a transmitter taking into account the dependence of efficiency on the number of amplifiers, and of determining their optimal value. The case is considered in which all modules in the transmitter have identical output power. An algorithm is presented for discrete control of the radiated power of a transmitter, taking into account the efficiency of adders. The efficiency of adders determines the effectiveness of regulation in controlling the power of signals in a radio link by means of transmitters designed according to the composition of powers principle. The effectiveness of controlling the transmitter's power is evaluated by means of the energy gain, defined as the ratio of the nominal radiated power in an unregulated system with the traditional design for the transmitter's high-frequency section, to the mean power in a system with control. With a transmitter able to radiate N power levels, for each power level of the transmitter there is a certain boundary value, μ_k^2, with which communications reliability requirements are fulfilled. This value is found upon condition of ensuring an identical signal-to-noise ratio in the receiver's input with various values of μ_k^2. An expression is found for the mean power when controlling by taking into account the efficiency of the adding circuit, and for the energy gain gotten when taking this same factor into account. Curves are shown, illustrating the relationship between the energy gain and the number of power amplifier modules with various variances in distribution of oscillation phases. Under specific conditions, with this variance equal to zero, the energy gain increases monotonically with an increase in the number of modules and with this variance greater than zero the gain first increases, reaches a certain maximum, and then slowly diminishes. It is demonstrated that with an increase in communications reliability requirements the optimal number of amplifiers increases. Figures 2; references: 2 Russian.
[132-8831]

DIRECTIONAL PROPERTIES OF PASSIVE REFLECTOR RELAYS

NAFIKOV, Yu. I.

[Abstract] The radiation patterns of passive reflector relays must be con-
sidered in planning radio relay systems, including determination of electro-
magnetic compatibility. Equations are presented for determining the radiation
patterns of flat, generally rectangular, passive radio relay reflectors
excited by planar waves. The case of a two-element reflector in which the
field is intended to be reflected by both elements in sequence is studied.
It is possible in this case that one of the side lobes of the primary reflector
will be pointed in the direction toward the next antenna along the link,
creating an interfering signal with the same characteristics as the useful
signal but a different phase due to the difference in path length. None of the
four major side lobes of a flat reflector should be directed toward the receiving
antenna. Slots where reflector elements are joined may also cause deteriora-
tion of relay link performance. Figures 7; references: 7 Russian.
[205-6508]

METHODS OF CALCULATING OPTIMUM NUMBER OF TECHNICAL PERSONNEL

GRESHILOV, A. A., candidate of physico-mathematical sciences, docent, sector
chief; DRUZHININ, V. V., engineer; TEREKHOV, V. S., scientific worker;
TROYANKER, A. U., sector chief; and VERKINA, I. A., senior engineer, Moscow
Oblast, Scientific Research Institute of Communications (MONIIC)

[Abstract] In order to ensure the most cost effective utilization of technical
personnel in an enerprise, it is necessary to optimize both the combination
and the interaction of persons involved in the operation. This can only be
done when labor norms are available, a time norm (time required for performance
of a unit task, i.e., one operation or a complete set of operations on one
piece of equipment) being the most precise. The total technical personnel in
an electrical communication enterprise consists of a fixed group performing
definite tasks with known parameters and a variable group performing also tasks
characterized by parameters which are random quantities. Any appropriate
minimizable target function can be selected as a basis for optimizing the size
of technical personnel under the constraints of a given organizational structure.
The problem can then be reduced to a system of equations of work time balance
and solved by the method of programming in the class of whole numbers. The
critical part of the problem is evaluating the number of the variable technical
personnel. Linear programming is not being applicable here and statistical

analysis based on data sampling is required. Rather accurate results can be obtained by application of the queuing theory. This is illustrated by calculations for a group of telegraph communication systems with the number of channels 526, 104, 1107, and 3013 respectively. Tables 3.
[183-2415]

MORE ATTENTION TO PROBLEMS OF CORROSION PROTECTION

NIKOL'SKIY, K. K., candidate of technical sciences, chief of laboratory, Central Scientific Research Institute of Communications (TSNIIS)

[Abstract] Corrosion of metals costs the national economy 13-14 billion rubles annually, one-sixth of all steel produced replaces steel lost through corrosion. One very critical item is irreversible loss of metal in underground communication equipment, especially in unattended repeater stations, with attendant service interruption. Protection of cables is a problem the solution of which begins in the design stage and must be followed through in subsequent manufacture, installation, operation and maintenance. Further complete immunization to corrosion will require more effective scientific-research and experimental-engineering effort, a substantially improved quality of protective sheathing and coating, a substantially improved performance of design and manufacturing quality control, production and distribution of protective equipment in necessary quantities by responsible enterprises, full compliance with specified installation procedures, and adequate field inspection and maintenance. The essential common ingredient of all these counter-measures is selection and management of personnel. There are huge deficiencies in the availability of qualified specialists and in the interaction between communication enterprises. This gap must be filled in order to implement a thorough inspection and correction program during the 1983-85 period, specifically in urban and interurban telephone networks, buried coaxial and symmetric cables being particularly vulnerable. A schedule for subsequent periodic inspections must be set up and special attention must be paid to protection of equipment which did not require it before.
[183-2415]

COMMUNICATIONS OVER COAXIAL POWER TRANSMISSION LINES

KALYUZHNYY, V., senior scientific research workers, All-Union Scientific Research Institute of Electric Power Engineering (VNIIelektroenergetikh), Moscow

[Abstract] Expansion of the unified national communications network involves the expenditures of large amounts of money and increasingly more nonferrous for the acquisition of communications cables. It is possible to organize communications through balanced coaxial cables which can also be used for the

transmission of electric power. West German experience indicates that communications cables built into high-voltage electric power transmission line conductors are an order of magnitude more reliable than buried communications cables. Electric power transmission lines carry at least three conductors. If two insulated copper or bimetallic conductors are built into each such line, at least 36 telephone channels can be accommodated. The idea is supported by the leaders of many ministries and departments, but has not been implemented largely because of the resistance of the USSR Ministry of Power Engineering. The author calls for further comprehensive study of the problem with development of coordinated decisions.
[212-6508]

CALCULATION OF MINIATURE STEPWISE TRANSITIONS FROM RECTANGULAR WAVEGUIDE TO ROUND

STEPANENKO, P. Ya.

[Abstract] In reducing the dimensions of polarization modulation devices there are strict requirements for the lengths of the stepped junctions used for transforming the wave of the rectangular waveguide into the wave of a circular waveguide, and in a number of cases it is necessary to use matching junctions containing one or two steps. A procedure is developed for designing miniature junctions with improved characteristics. The problem is essentially that of calculating with the required precision the normalized wave impedances, or admittances, of steps with a complex cross section. As the sought ratio of characteristic admittances the real part of a stationary functional from an earlier study (Farmer, 1956) is used, for the admittance of the junction of a rectangular and truncated round waveguide. The case is discussed where the connecting hole is in line with the cross section of the rectangular waveguide. Formulas are derived from which a calculation is made of the dependence of the ratio of characteristic admittances on the transverse dimensions of the truncated round waveguide. The results are given of calculations for the case where the radius of the truncated round waveguide equals the diagonal of the rectangular waveguide with a ratio of sides of 0.435. It is assumed that the dimensions of the waveguides to be matched, the type of frequency characteristic, the number of steps, and the central frequency of the junction's bandwidth are assigned. Then, knowing the critical wavelength in the rectangular waveguide, a computation is made of parameter α at the central frequency, f_0, where $\alpha = r_2/\Lambda$, where Λ is the wavelength in the rectangular waveguide and r_2 represents half of the long dimension of the rectangular waveguide. From curves a determination is made of the ratio of characteristic admittances and of the wave impedance differential of the waveguides being matched for the value found for . A determination is then made of the normalized wave impedances of the steps, with the use of tables from an earlier study (Fel'dshteyn, et al., 1967). The heights of the steps are then found for parameter α. The lengths of the steps are calculated at the central frequency of the bandwidth. The reactances of the junctions are determined experimentally and the lengths of the steps are corrected, using the formulas presented in

Stepanenko, et al., 1975. The feasibility of practical utilization of the
theoretical results obtained here for calculating miniature stepwise transi-
tions from a rectangular waveguide to a round has been confirmed by experi-
mental data. Figures 3; references 7: 4 Russian, 3 Western.
[132-8831]

COATINGS FOR OPTICAL COMPONENTS MADE OF POLYMER MATERIALS

ALEKSANDROV, G. A.

[Abstract] A large variety of optical components are presently made from
polymers such as polymethylmethacrylate, polystyrene, polycarbonate and their
copolymers. The use of such polymer optics is limited in a number of cases
by poor thermal stability, high thermal coefficient of linear expansion, low
abrasion resistance of the surfaces and high specific surface resistance.
These difficulties can be overcome through the use of the appropriate coatings.
This paper briefly reviews primarily Soviet and Western patent literature
covering recent technological achievements in the following fields:
1) Antistatic coatings; 2) Abrasion resistant and antistatic coatings;
3) Hydrophilic coatings; 4) Electrically conductive coatings (transpatent);
5) Transmissive coatings; 6) Light filtering and beam splitting coatings; and
7) Mirror coatings. References 65: 19 Russian, 46 Western.
[93-8225]

COMPUTERS

IMAGE QUALITY ENHANCEMENT TECHNIQUE FOR HOLOGRAPHIC INTERFEROMETERS

BEKETOVA, A. K. and SILINA, T. V.

[Abstract] In the case of holography using a transparency, a diffuse target
or a phase inhomogeneity with a single plane or a spherical wave from a
coherent source, uniform field illumination is impossible because the light
beam is distorted by diffraction and interference patterns produced by various
particles and objects. This results in diffraction noise, which can be elimi-
nated by inserting a diffuse in the illuminating beam, but this in turn leads
to the appearance of so-called subjective or "speckle" noise. This paper
reduces both speckle and diffraction noise in a holographic systems by
simulating an extended light source by means of the insertion of a diffraction
grating into the objective beam of a holographic interferometer. The source
is simulated in the form of an infinitely narrow slot by using several diffrac-
tion orders in the illumination and restoration of the beam. A laboratory
model of such an interferometer employed a diffraction grating with 100 lines/mm
and illuminated the region being studied with the 0 and $\pm$ 1st diffraction
orders. The simulation of an extended source substantially increased the
uniformity of the hologram field illumination. This is illustrated with photo-
graphs of the interference patterns for both point and extended sources; a
thread was introduced into the beam to increase the noise, and its diffraction
pattern is clearly seen in the point source photos, while it is barely notice-
able with the diffraction grating. Besides reducing noise interference in the
restored picture and enhancing field illumination uniformity, the technique
also improves focusing. Figures 2; references 8: 1 Russian, 6 Western,
1 international congress.
[93-8225]

ELECTRON DEVICES

PLOTTING LIGHT WAVE FRONT FROM LATERAL SHIFT INTERFERENCE PATTERNS

SHEKHTMAN, V. N.

[Abstract] Problem solving with the use of interferometric techniques in
such fields as gas dynamics reduces in practice to the plotting of the wave
front distorted by the object being studied. To determine the wave front is
to find the amplitude of the electromagnetic wave phase distortions as a
function of the spatial coordinates. These functions are obtained from shift
interference patterns for the intersections of the wave front with a plane
normal to the plane of the object, and extending in the direction of the wave
front shift. With an undisturbed field in the region of the shift pattern,
e.g., in the case of ballistic paths, the wave front plotting is not much more
complex than the same operation for interference patterns using a standard
light beam. However, additional data are required when the optical inhomogeneity
occupies in entire interference field. This paper proposes methods for
eliminating the ambiguities which occur in such plotting which are based only
on an analysis of the patterns obtained with various settings of the inter-
ferometer. Three cases of the alignment of a lateral shift interferometer
are treated: 1) The width of the adjustable interference band, e_0, is much
greater than the light field being studied; 2) The value of e_0 is finite and
the wave front shift is perpendicular to the adjustment interference band; and
3) The value of e_0 is finite and the wave front shift is parallel to the inter-
ference band. A shift in any direction relative to the band can be reduced
to the second case. Relevant analytical expressions are adduced and the specific
application of a Michelson interferometer is illustrated, showing the inter-
ference patterns. Figures 4; references: 4 Russian.
[93-8225]

INFLUENCE OF TRANSVERSE MAGNETIC FIELD ON TRANSFER OF ELECTRONS BETWEEN VALLEYS IN GALLIUM ARSENIDE

BORODOVSKIY, P. A., OSADCHIY, V. M. and TOKAREV, A. S., Institute of Semiconductor Physics, Siberian Branch, USSR Academy of Sciences, Novosibirsk

[Abstract] New results are presented from the Monte-Carlo method of computation as well as experimental results on the influence of a transverse magnetic field on the transfer of electrons between valleys in gallium arsenide at 300 and 77K. The 3-valley Γ-L-X model of gallium arsenide was used, which provided good agreement of the calculated variation in mean drift velocity as a function of electric field v(E) with experimental results. The Gunn oscillation voltage is found to increase in a transverse magnetic field. The increase in population of upper valleys at B=3 and 6 T found by the authors was unexpected. The experimental studies were performed on pure epitaxial film specimens about 70 μm thick with an electron concentration of about $3.5 \cdot 10^{14}$ cm^{-3} and a Hall mobility of 8200 cm^2/V's at 300 K. Figures 5; references 13: 7 Russian, 6 Western.
[220-6508]

PHOTOIONIZATION OF DEEP LEVELS IN GALLIUM ARSENIDE AND GaAs$_{1-x}$Sb$_x$ FILMS

BOBYLEV, B. A., MARCHENKO, N. Ye., CHIKICHEV, S. I., KRAVCHENKO, A. F., YUDAYEV, V. I. and KHAYRI, Ye. Kh., Institute of Semiconducting Physics, Siberian Branch, USSR Academy of Sciences, Novosibirsk

[Abstract2 This work is dedicated to determining the photoionization and photoneutralization thresholds of deep A- and B-centers in gallium arsenide films and their changes upon transition of gallium arsenide to a GaAs$_{0.85}$Sb$_{0.15}$ solid solution. A combined method of measuring photocapacitance and thermostimulated capacitance was used in the determination. This method allows optical thresholds to be determined with superimposition of photocapacitance thresholds from various deep levels. The solid solutions were produced by liquid phase epitaxy. The experimental data indicate that the preferential ohotoionization of deep levels through L valleys is not related to differences in Γ and L valley state densities, but may be related to the structure of the optical transition matrix element. Figures 3; tables 2; references 12: 1 Russian, 11 Western, 1 in translation.
[220-6508]

ESTIMATE OF MAXIMUM BANDS FOR MODULATION OF ELECTRON BEAM BY SYSTEMS OF
UNCOUPLED RESONATORS

BELYAKOVA, L. F., GRADOVA, S. N., ZAKHAR'YASHCHEVA, Ye. A., TRUSHIN, S. A.
and FILIMONOV, G. F.

[Abstract] Systems of isolated resonators are employed in broadband klystrons
for premodulation of the electron beam. An estimate is made of the maximum
bands for modulation of the electron beam by systems of isolated resonators
and a determination is made of ranges of their parameters with which maximum
bands can be realized. Formulas of the theory of weak signals are used for
the purpose of optimization of multiresonator systems in a single band. This
approach was used in order fully take into account processes in the gaps of
resonators and to avoid the "infinitely narrow gap" approximation. Equations
of the linear theory are used in matrix form to relate the amplitudes of
current waves and velocities of the beam in the inputs of neighboring
resonators. By symmetrizing the effectiveness function, resulting in an
infinite growth of it with too high and too low current amplitudes, the number
of calculated amplitude-frequency characteristics is reduced by an order of
magnitude. Bunchers with a rather great number of bunching resonators are
discussed. The object of optimization was the natural frequencies of the
resonators and their "cold" loaded figures of merit. Computation results
are presented in the form of graphs illustrating the dependences of limiting
modulation bands on the legnth of bunchers and wave impedance parameters.
The optimal distribution of the current in the input of the output resonator
was made constant at 1.75 for the entire band. For each pair of values of the
number of bunching resonators and R_0/ρ_m, where $R_0 = U_0/I_0$ and ρ_m is the
wave impedance, the modulation band was gradually expanded until its limits
were reached, after which nonremovable gaps appeared in amplitude-frequency
characteristics. The maximum band was determined from the change in computed
values of I_k, representing the absolute value of the dimensionless current
amplitude at the frequency in the input of the output resonator, over the
range of $\pm$ 10 percent of $I_{k, zad}$, representing the value of I_k which is
desired to be arrived at as the result of optimization. Modulation bands are
increased along with ρ_m and reach approximately 20 to 30 percent with $R_0/\rho_m =$
= 12 to 15. The maximum modulation bands also increase with the bunching
length. Optimal values of "cold" loaded figures of merit lie in the range of
10 to 100 and tend to diminish with an increase in the individual modulating
capacities of the resonators, i.e., with a reduction in R_0/ρ_m. The opinion
has prevailed that increasing the wave impedances of the resonators is useful
and results in expansion of the modulation band of multiresonator devices.
This is true up to certain limits where the individual modulating capacities
of the resonators become too high. These limits depend in a complex manner
on all parameters of the device, and primarily on the minimum "cold" loaded
figure of merit, the number of bunching resonators, the length of the buncher
and the level of the gain. Figures 2; references 5: 1 Russian, 4 Western
(1 in translation).
[132-8831]

TENSOELECTRIC PHENOMENA IN π-$\vee$ n-STRUCTURES OF GaAs(Fe)

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Institute imeni V. D. Kuznetsov, affiliated with Tomsk State University,
Tomsk

[Abstract] A discussion is presented of the results of a study of the
influence of hydrostatic compression at 0 to 6 kbar on the inverse VAC branch
of π-$\vee$-n-structures. The study was performed on specimens of GaAs doped
with terrurium with an initial donor impurity concentration of $5 \cdot 10^{16}$-10^{17} cm^{-3},
into which iron was diffused. As hydrostatic pressure is applied the back
current decreases, while V_p increases linearly. The variation of current
pressure sensitivity as a function of bias voltage is studied. The studies
show that when microplasma breakdown occurs, the tensoelectric properties of
the π area have a significant influence on the tensosensitivity of the
structures studied. Figures 2; references 11: 8 Russian, 3 Western.
[220-6508]

INFLUENCE OF CONCENTRATION HETEROGENEITIES ON SPECTRAL PROPERTIES AND QUANTUM
EFFECTIVENESS OF GaAs $\langle$Si$\rangle$ LIGHT DIODE STRUCTURES

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USSR Academy of Sciences, Moscow; Institute of Physics, National Scientific
Research Center, Socialist Republic of Vietnam, Hanoi

[Abstract] Detailed studies are presented of the influence of concentration
heterogeneities on the spectral characteristics and quantum effectiveness of
GaAs Si light diode structures. The conditions of production of epitaxial
structures were varied both by varying the content of Si in the liquid phase
and by changing concentrations in the gas phase. The temperature was held to
$\pm 1°C$, which is not sufficient for effective liquid phase epitaxy, particularly
for doping with amphoteric silicon. The quantum effectiveness and homogeneity
of spectral characteristics of light diodes could be improved significantly by
more rigid control of technological parameters, particularly temperature,
during the growth period. The best diodes will be produced with minimum Si
concentration in the liquid phase (0.5% or less). Figures 2; references 7:
5 Russian, 1 Vietnamese, 1 Japanese.
[220-6508]

ANALYSIS OF OPTICAL SYSTEMS FOR COHERENT SPECTRUM ANALYZERS

KOLOBRODOV, V. G. and TYMCHIK, G. S.

[Abstract] The optical system of a coherent spectrum analyzer can have two basic configurations: 1) The input transparency with the recorded spatial signal to be studied in the form of a variable transmittance, is positioned in front of the Fourier objective; and 2) The input transparency comes after the Fourier objective. Using the classical Huygens-Fresnel principles in general form, this paper provides a detailed mathematical analysis of the design of such optical systems; in contrast to other approaches found in the literature, the actual phase distortions which occur are not disregarded. This makes it possible to determine the optimum geometric dimensions of the system and to eliminate completely or reduce the level of second order phase distortions in the Fourier transform of the original signal. Equations are written and solved for the field distribution in the spectral analysis plane for both of the above configurations. The phase distortions of the spectrum produced in a coherent analyzer can be eliminated only in the first configuration, where the free space distance between the input transparency and the subsequent Fourier lens is equal to the spatial frequency of the signal. The analysis can also be applied to optical systems for such analyzers with an extended radiation source. Figures 1; references: 3 Western in translation.
[93-8225]

PERFORMANCE ANALYSIS OF ANGLE MEASUREMENT INSTRUMENTS DESIGNED AROUND LOW POWER TELESCOPIC SYSTEMS

VUSTENKO, V. I. and GOLUBOVSKIY, Yu. M.

[Abstract] A bundle of parallel rays is produced by a radiation source through a stop and an objective lens; it falls on a low magnification telescope, which is rigidly coupled to the object being tested. The rays which pass through this telescope are deflected through a certain angle from their initial direction and then fall on a second telescopic system, having a magnification which is the reciprocal of the first telescope. This configuration, which is used to measure the rotation angle of the object under test, was experimentally tested using a model designed around two GS-5 goniometers. The system permits the monitoring of target rotation in a range of $\pm 6°$ with an error not exceeding 1.5 angular minutes. The calculated and experimental curves for the inherent error of the device with two telescopic lenses are plotted as a function of the angle of rotation of the target, showing quite good agreement. The relevant analytical expressions are adduced; the assumption that telescope system aberrations have a substantial impact (primarily distortions) on measurement error is confirmed. Figures 2; references: 4 Russian.
[93-8225]

FUNCTIONAL INFRARED RADIATOR FOR CALIBRATION OF MEASURING CHANNEL OF THERMOSCOPES

PADALKO, G. A.

[Abstract] Existing unisurface and multisurface infrared radiators with precise temperature stabilization and regulation for calibration of the measuring channel of thermoscopes are not sufficiently accurate, because of the nonlinear

temperature dependence of the receiver output signal. A new infrared radiator has been developed with which almost any dependence of the surface temperature on the surface dimension in one direction is realizable so that calibration of the entire thermoscope for linearity of its transfer function becomes unnecessary. This radiator, accordingly called functional, consists of an electric heater element made of high-resistivity sheet metal (michrome or Permalloy), a resistance thermometer, a temperature setter, and a current regulator. The element has the shape of a thin wedge, of uniform thickness, so that its cross section and thus the current density vary lengthwise with the width. The radiator heats nonuniformly and any desired longitudinal temperature profile can be attained by appropriate design of the wedge profile. This problem is solved graphically so as to avoid unwieldy analytical design calculations. A wedge thickness as small as 0.2-0.5 mm ensures a sufficiently high electrical resistance. Small mass and large surface area ensure intense heat transfer and a short heatup transient period. A 1% error of temperature measurement results in a 2.5% inaccuracy of the temperature profile sought. Distortion of the temperature field by nonisothermality of the heat transfer at the thermometer location has been determined with a "Rubin-2" thermoscope, an IS-568A resistance thermometer, and the radiator at 30°C, the equipment having a resolving power of 0.1°C. The accuracy of the thermometer was checked with this thermoscope as comparator and an RP-724 radiator as reference. The temperature of radiator segments can be made to stabilize within the 20-100°C range, with temperature drops of 2-50°C. Figures 2; references: 5 Russian.
[204-2415]

NEW REFERENCE ETALONS FOR CHECKING MICROWAVE INSTRUMENTS

GERBINSKAYA, L. P., KHVOROSTOV, B. A. and SHTUDEN, L. K.

[Abstract] At the "Etalon" plant in Omsk production has begun of a set of Class-1 impedance and voltage standing wave ratio (KSVN) reference etalons, for calibration and checking of respective measuring instruments with type-III connectors according to GOvernment STandard 13317-80 in the 0.02-4 GHz frequency range. The set includes coaxial loads in the form of low-loss waveguide segments with S2-10 resistors as center conductors and with certified phase of the reflection coefficient, and phase shifting transmission line segments without dielectric mounting. The loads are quasi-lumped within the 0.02-1.25 GHz range, actually tested at 1.25 GHz (phase of reflection coefficient) and with direct current (resistance). In the 1.25-4 GHz range the loads have been certified with existing etalons. The range of nominal sizes is R_0= 16.8-150 ohms and VSWR= 1.0-2.0, the maximum dissipation of microwave power in each is 0.25 W. Tables 1.
[204-2415]

ADAPTIVE CONTROL OF COHERENT MEASURING DEVICE FOR ANGULAR VELOCITY

BAYBORODIN, Yu. V. and CHADYUK, V. A.

[Abstract] For optimal control of a coherent angular velocity meter it is
necessary to define its mathematical model, the criterion for optimality of
its operation, and a control method effectively minimizing the instrument's
errors in keeping with the optimality criterion chosen. In order to construct
a mathematical model of the meter it is necessary to determine sufficiently
accurately the characteristics of the instrument, i.e., the dependence of its
output signal, frequency difference ΔF, on the parameters of the input
signal, i.e., angular velocity Ω, and deterministic effects. In this case
the deterministic effects are the temperature field and magnetic field. Their
parameters can be measured by appropriate sensors and taken into account in
compensating for errors of the output signal. Experiments have shown that the
error in the difference frequency is with a certain approximation an additive
function of the external temperature, the internal temperature, i.e., that of
the meter, and the strength of the external magnetic field. These characteristics
are determined from a series of tests in which input quantities are quantized
and a determination is made from experimental data of the expectation of the
output quantity for each level of quantization of the input variable, and the
analytical form of the corresponding characteristic, i.e., a regression
function, is determined for the entire set of expectations. It is shown that
the mathematical model of a coherent angular velocity meter is generally non-
linear and for the input variables discussed the output signal is an additive
function, i.e., a regression function, of the individual characteristics. A
mathematical model is presented for a coherent angular velocity meter which is
linear in a specific instantaneous interval and an expression is found for the
relative error in linearization for this model. An expression is presented
for the criterion for optimality of its operation. This "error criterion" is
minimized by supplying to the control element four step-voltage control signals
for which error criteria are determined, and on the basis of these data, error
criteria are predicted for the remaining quantization levels of the control
signal, and control corresponding to a minimum of the error criterion is
selected. For the case of a two-channel meter, optimal control arrived at as
the result of a search process in the first channel is supplied to the control
element of the second channel. The adaptive control system determines for
several future control intervals the change in external and internal operating
conditions of the instrument, and on the basis of these data predicts the
control which will minimize the mismatch between the real and model outputs.
The use of an adaptive control system in meters of this sort makes it possible
to increase their accuracy by at least an order of magnitude. References:
4 Russian.
[132-8831]

ON MEASURING RESOLUTION OF FINE STRUCTURE CATHODOLUMINESCENT SCREENS

PODGORNOVA, L. I., SHAMANOV, A. A. and BEGUCHEV, V. P.

[Abstract] The resolving power of cathodoluminescent screene is usually
measured visually using spatial test patterns, primarily hatch marked one or
two-dimensional optical test patterns and radial patterns, which are employed
in photolithography and optics. Standard hatch patterns where each of the
25 elements of the patterns contains 4 groups of parallel bright and dark
bands oriented with respect to the hatch marks of the adjacent groups at 45°
have become widespread in Soviet practice. In resolution measurement instru-
ments which are extensively used at the present time, the resolving power of
screens is measured by means of electron lens compression of the image of a
transparent metal grid when the image is observed in a microscope. The overall
resolution of such instruments usually ranges from 370 to 440 lines/mm at
wavelengths of from 450 to 550 nm. The shadow image compression technique
became widespread in its time because of the lack of strong metal test patterns
with the requisite line density per mm. Now though, fabrication technology
for test patterns with a transparent metal design makes it possible to obtain
significantly higher spatial frequencies. Comparative measurements of the
resolution of screens made with resolving power meters using experimental pro-
totypes of transparent metal patterns (the GOI No. 1 – test pattern No. 1
made by the State Institute of Optics imeni S. I. Vavilov) fabricated by means
of electrotyping, and without using an electron lens or the shadow image
compression method, demonstrated the superiority of the new test patterns.
The resolution of the best powder screens, defined as the half-width line
scattering function in the image of a narrow shining slot, is 180 to 200 lines/mm.
Because of this, transparent metal patterns with a density of up to 200 lines/mm
can be employed with electron excitation of the screens to check their resolu-
tion. Despite the possible correction of the grid image compression technique,
the measurement of screen resolution using GOI optical test patterns provides
the greatest clarity and conformity in resolving power measurement instruments
and better reflects the conditions governed by the light scattering processes
in the screens. Figures 1; references 11: 10 Russian, 1 Western in translation.
[93-8225]

CHANGEOVER TO INTERNATIONAL SYSTEM OF UNITS IN CIVIL AVIATION

YURSKOVA, N. A. and IL'INA, L. N.

[Abstract] An elaborate plan of research on changeover to International System
units in civil aviation in the USSR has been developed, covering technical and

economical as well as safety aspects of such a changeover. The most critical
item is conversion of airborne pressure measuring instruments, mainly from the
standpoint of flight crew and tower personnel retraining and adaptation.
Transition will be facilitated by use of three units of pressure throughout
intermediate period: "mm Hg" along with "millibar" and "hectopascal", the
"bar" being scheduled to be withdrawn finally on 31 January 1985. Similarly
"nautical mile" and "foot" along with "knot" will be replaced with "kilometer"
and "kilometer per hour", respectively. Here the final date has not yet been
set, 31 December 1990 being recommended as the earliest possible. Such a
long transition period is dictated by the widespread use of nonmetric units
in various countries and their great convenience in many instances. The
changeover will require a great deal of standardization and documentation.
It will also spill over into civil aviation schools and academies. References:
2 Russian.
[204-2415]

DEVICE FOR CHECKING NAUTICAL CHRONOMETERS

TABACHNIK, E. I. and KORNIYENKO, I. S.

[Abstract] The model PPKh-1 device for checking nautical chronometers operates
together with an electronic-counter frequency meter, measuring the time
correction within ± 0.02 s accuracy with a daily drift not exceeding 60 s. The
timing of minute signals can be synchronized within ± 1 ms with time signals
from transmitters of the Government Time and Frequency Service radio stations.
The device, actuated by acoustic signals, generates a sound signal and a light
signal as well as pulses triggering the frequency meter, all synchronized with
discrete positions of its minute and second hands. A 1-MHz quartz oscillator
in the frequency meter generates sinusoidal signals which a Schmitt trigger
converts to a sequence of square pulses, the latter appearing at the input
of the main channel with two frequency dividers (division ratio 10^6 and 60,
respectively) and at the input of the control channel with one frequency divider
(division ratio $6 \cdot 10^7$). The three main additive components of the correction
measurement error are, respectively, caused by: 1) Instability of the time
coordinate of a pulse which triggers the frequency meter; 2) Frequency error
of the quartz oscillator with resulting time shift of a triggering pulse; and
3) Error of synchronization (maximum ± 1 ms) with second signals from the
Sovernment Time and Frequency Service. Figures 1; references: 2 Russian.
[204-2415]

HOLOGRAPHIC INTERFEROMETER WITH ENHANCED SENSITIVITY FOR CHECKING SHAPE OF
OPTICAL SURFACES AND SYSTEMS

LARIONOV, N. P.

[Abstract] It is preferable when testing optical surfaces and systems to use
test instruments in which the defects of the tested component are amplified
in the wave front of the signal wave. This requirement is met in interfero-
meters in which the signal wave is reflected twice from the test surface or
passes through the test system twice. Auxiliary spherical or flat mirrors
are employed in the signal branches of such interferometers; the mirrors are
installed so that the wave reflected from them propagates in the opposite
direction and has an inverted wave front. This provides for an autocollimated
beam path and double reflection from the test surface or double passage through
the optical system. These interferometers are designed for the testing of
second order aspherical surfaces and optics which produce a spherical or plane
wave at the output. To test lenses and systems which do not meet this require-
ment, as well as more complex aspherical surfaces, an auxiliary aspherical
mirror must be used. The fabrication of such a mirror presents insuperable
difficulties in some cases; these difficulties can be circumvented if
synthesized holograms are used as the auxiliary mirror, which converts the
signal wave impinging on it to an inverted wave front propagating in the
opposite direction. The production of such autocollimation mode holograms
poses no serious technical difficulties and three configurations are proposed
for optical system testing: 1) For concave aspherical surfaces; 2) For convex
aspherical surfaces; and 3) For positive lenses and optics. The basic instru-
ment configuration contains a laser light source which illuminates an expander
lens set, followed by a beam splitter, which feeds a flat reference standard
reflector and an objective lens, as well as a second objective lens and stop
which focus the return rays on the readout plane. A prototype instrument to
test concave aspherical surfaces is shown; the unit was used to test a concave
parabolic mirror with a light diameter of 150/60 mm and a relative aperture
of 1:1. The synthesized hologram was produced on a convex spherical substrate
with a radius of curvature of 160.06 mm. The test procedure is described and
the improved sensitivity is illustrated by the interference patterns from the
parabolic reflector. Figures 3; references: 5 Russian.
[93-8225]

MODEL 'IMPI' INSTRUMENT FOR MEASURING POWER OF STRAY RADIATION

MUSATOV, V. A., NIKIFOROV, A. N. and ROMANOV, V. A., Scientific Research
Institute of Radio Engineering

[Abstract] The instrument for measuring the power of stray radiation (IMPI)
includes directional couplers, a commutator switch, and the industrial high-
precision selective microvoltmeters SMV6 (0.1-30 MHz) and SMV8 (30-1000 MHz).
It measures the power of incident and reflected waves upon their separation by
the directional couplers (directivity 30 dB) inside a coaxial feeder at the
transmitter output terminal. The required 0.1-230 MHz frequency range is
covered by two types of directional couplers, NO-1 for 0.15-30 MHz connected
to a long-wave or medium-wave transmitter and NO-2 for 1.5-230 MHz connected
to a short-wave transmitter. The commutator switch consists of a coaxial
relay and a smoothly tunable bank of band elimination filters. This instrument
differs from the conventional M2-22 and M2-23 instruments by including those
SMV6 and SMV8 microvoltmeters on the receiver side, each containing an oscillator
which can be tuned to the frequency of measured radiation so that the error
caused by nonuniformity of the transmission coefficient along the commutator
channel will be eliminated. The wide dynamic range of the receivers makes
possible measurement of power ranging from a few microwatts to hundreds of
kilowatts with an error not exceeding ± 2 dB. The instrument determines the
level of incoming signals and then computes (with a B3-18A or Bs-18M micro-
calculator) the power on the basis of the readings, taking into account the
channel insertion loss. At small traveling-wave ratios it is recommended that
readings be taken on the inrealy expanded scale, to ensure a resolution of 0.1
dB. At large traveling-wave ratios it is permissible to disregard the amplitude
of reflected waves in computation of the radiation power.
[183-2415]

LOWER BOUNDARIES FOR SCATTERING OF ELECTROMAGNETIC WAVES ON SMALL DIELECTRIC
PARTICLES OF COMPLEX SHAPE

KAZANTSEV, V. P., Krasnoyarsk State University

[Abstract] The analysis is conducted with the assumption that: 1) Dimensions
of the particles are significantly less than the wavelength of the scattered
wave in the material of the particles; and 2) Magnetic permeability is equal
to 1, dielectric permeability greater than 1. The upper boundary is calculated
on the assumption that the polarizability of any dielectric particle having
cubic symmetry is less than the polarizability of any spherical layer of
the same volume if the sphere has a radius equal to the outside radius of a
spherical layer and includes the area and space occupied by the particle.
The error in estimating the scattering cross section of electromagnetic waves
on small particles in the form of right polyhedrons is not over 10%.
References: 3 Russian.
[222-6508]

SELECTION OF OPTIMAL MAGNETIC RECEIVER PARAMETERS FOR PATH SEEKING DEVICES

OYSGEL'T, M. G.

[Abstract] Finding places where breakdown has occurred in communications cable
insulation is quite difficult because it requires measurement of the electro-
magnetic field generated by a spark within cable insulation buried 1 to 2
meters in the ground. Magnetic receivers and multiple-turn inductance coils
have maximum sensitivity for such work with minimum mass. Equations are
derived for selection of magnetic receiver parameters. These receivers can be
used to construct special instruments used to seek the locations of electrical

communications cable insulation breakdown. The new magnetic receivers are smaller and lighter than previous models while retaining equal electrical properties. The new defices are made of type PEV-1-0.2 copper wire with 4000 turns in a 1 kg coil. Three years operation have proved their reliability. Figures 2; references: 3 Russian.
[205-6508]

SPECIFIC FEATURES OF MAGNETIC FOCUSING FIELD FORMATION IN MULTIPLE SLOT LENS

VASICHEV, B. N.

[Abstract] The distribution of the induction amplitude along the axis of an electron lens which has a periodic magnetic field is analyzed for the case of axial symmetry, where the field is produced by a series of ring magnets with nonmagnetic gaps between them. The equation describing the overall induction in the system is written in matrix form; while not solved in detail, it is used to illustrate the impact of component imprecision on system performance. Errors in determining the values of the coefficients which define the contribution of each ring field in excess of 0.5% or errors in specifying the overall induction amounting to 1% lead to errors in the determination of the induction caused by a particular element or gap which run up to 50%. Studies show that the precision in component fabrication for multislot electron optics should be quite high, about 0.01%; this applies as well to the magnetic homogeneity of the materials used in the manufacture. Figures 2; references: 1 Western.
[93-8225]

MICROWAVE THEORY AND TECHNIQUES

CONVOLUTION DEVICE FOR MICROWAVE SIGNALS UTILIZING BULK ACOUSTIC WAVES

VLASOV, A. B. and KRAVCHENKO, V. I.

[Abstract] A convolution device based on a delay line utilizing bulk acoustic
waves is used in apparatus for optimal processing of radio signals for the
purpose of computing a specific correlation integral in real time for the
microwave band. The results are given of a study of a device for convolution
of microwave signals which employs the method of exciting acoustic signals
from the face surfaces of a piezoelectric acoustic line in place of film-type
transducers. The device consists of an exciting resonator, input connectors,
the acoustic line, an integrating resonator, an output connector and tuning
screws. Special attention is paid to studying the influence of the configura-
tion of the electrodes of the working gaps in which the faces of the acoustic
line are placed on the device's operating efficiency. The output power is
determined by integrating for the acoustic line's space the specific electro-
magnetic energy of the convolution signal and by averaging for the integration
time. The operating efficiency is determined by the equation $E = P_{vykh}/(P_{vkh1}-P_{vkh2})$ where P_{vkh}, P_{vkh1} and P_{vkh2} are the power of the output signal, the
input signal being processed and the reference input signal, respectively. It
is shown that the operating efficiency of this device is determined to a con-
siderable extent by the configuration of the electrodes of the working gaps
of the matching resonators and that the efficiency increases with a reduction
in the height of the gap and an increase in the wedge angle. The relative
diameter of the apex of the fact electrode of the working gap, d/D, should
equal 0.1 A convolution device of this sort which has been manufactured
processes signals with frequency of 1.5 GHz and an input signal duration of up
to 6   s with an 8-MHz bandwidth. A lithium niobate acoustic line measuring
3 X 3 X 50 mm with the diameter of the faces equaling 3 mm is used in this
device. The device uses an integrating resonator of the magnetron type which
is tuned to the frequency of the 3-GHz output signal by means of screws placed
along the entire length of the acoustic line. The convolution signal power
was measured at 10^{-9} W which corresponds to an operating efficiency of approxi-
mately 10^{-10} W^{-1}. It was possible to achieve high efficiency by optimizing
the design of the working gap in spite of the use of less efficient electro-
acoustic transducers. Figures 4; references 6: 5 Russian, 1 Western.
[132-8831]

CALCULATION OF NONUNIFORM STRUCTURE WITH INTERNAL ROUND REGION IN DESIGNING INTEGRATED MICRODEVICES

YASHIN, A. A.

[Abstract] A discussion is presented of nonuniform structures with an internal round region used for implementing specific components in integrated micro-devices. An analysis is made of the limitations of the calculation methods used, including 1) Method of transforming one quarter of the cell; 2) Zhukovskiy function method; 3) Method of successive transformations; and 4) Semi-infinite region method. All the techniques discussed are based on the mathematical method of conformal transformations and are convenient for use in research and engineering. In the first method, by a number of successive transformations one quarter of the cell--a rectangle with a round corner cutout--is transformed into a rectangle with a homogeneous plane-parallel field. The accuracy of calculation is dependent on the degree of approximation of the initial trans-formation and on specific geometrical relationships of the cell. When using the formulas derived, with specific geometrical relationships the error is not greater than 1.2 to 1.4 percent. The Zhukovskiy function transforms the half-plane at axis z, with a cutout semicircle with its center at the origin, into a half-plane at axis z_1. This function approximately transforms half of the cell into a region quite close to a rectangle with a homogeneous field. With the specific geometrical relationships here the error in calculation by the formula presented is less than 1 percent. The method of successive transforma-tions is based on the principle of an approximate conformal transformation, known as the "exhaustion method" developed for application to calculating micro-electronic structures. A region of half of the cell at z is transformed into a higher half-plane at z_1, with a cutout curved segment. By the successive use of a transformation, the curved segment is "exhausted" and as a result the original region is transformed into a canonical higher half-plane and this is transformed into a rectangle with a homogeneous field. The accuracy of this method is infinite and is determined by the number of calculation points selected on the semicircle at z and by the number of "exhaustion" steps. This method makes it possible to calculate cells with inhomogeneities of random shape whose boundaries are assigned analytically or by tables. Under specific condi-tions, the calculation error is not greater than 1.5 to 2.5 percent. In the semi-infinite zone method, a semi-infinite zone with a round corner cutout at z is transformed into a higher half-plane and is then transformed into a semi-infinite zone at ζ with a homogeneous plane-parallel field. The maximum error in calculation is not greater than 2 to 3 percent. It is concluded that the procedures developed for calculating a nonuniform structure cover all cases important from the practical viewpoint, of the ratios of the length and the depth, t/a, and height and length, h/t, and make it possible to calculate para-meters and construct the pattern of a field described by a Laplace equation with boundary conditions of the third kind. The method of successive trans-formations enables accuracy of up to hundredths of a percent with any t/a and h/t. Figures 2; references: 7 Russian.
[132-8831]

POWER ENGINEERING

FIRST UNIFIED STANDARD SERIES TURBINE GENERATOR WITH CAPACITY OF 160 MW

KURILOVICH, L. V., engineer, KHUTORETSKIY, doctor of technical sciences, ANDREYEV, A. V., DROZDOVA, L. A., engineers, "Elektrosila" Production Engineering Association

[Abstract] A series of standard two-pole turbine generators is being developed to satisfy the requirements of both the USSR and CEMA member nations. It is planned that prototypes of these generators at all capacities up to 800 MW will be placed in production by 1985. The first turbine generator in this series, rated at 160 MW, has been designed and manufactured at the "Elektrosila" Leningrad Production Engineering Association. The TVV-160-2YeU3 generator is to replace the old TVV-160-2U3. This new standard generator has direct water-cooled stator windings, direct hydrogen cooled rotor winding with the gas intake from a gap, where the stator housing is filled with hydrogen at a pressure of 3 kgf/cm^2. The unit uses independent thyristor excitation. An air cooled generator is used as the exciter, the shaft of which is directly coupled to the rotor shaft of the main generator. The following improvements distinguish this first generator in the standard series from the TVV-165-2U3, which had been produced since 1959: The material input requirements have been reduced by approximately 20%; and the MTBF is 18,000 hours as opposed to the previous 12,000 h. The number of starts per year is up to 330 from 120; the total weight of the stator and rotor is 146 t as opposed to 176.6 t previously. The in-commission rate is 99.5% vs 99%. A variety of design improvements are described and illustrated with drawings showing the overall view of the generator, the end face of a wound stator, a cross-section through a stator slot, the end fact portion of the rotor and the seal detail of the rotor shaft. The results of test stand performance are given, including data on the temperature rise in various operating modes and the vibration of bearings in these modes. Test data confirm the major technical parameters of the unit. Figures 7; tables 4. [90-8225]

VOLNA-TYPE FAULT DETECTOR FOR LOCATING SHORT CIRCUITS TO GROUND IN OPEN WIRE
6 - 20 KV POWER NETWORKS

BORISOV, S. P., engineer, KARPOV, I. V., candidate of technical sciences,
BORUKHMAN, V. A., engineer, and KUZNETSOV, A. P., candidate of technical
sciences, Ukrainian Agricultural Academy "Soyuztekhenergo"

[Abstract] While the operation of the "Volna" fault detector is based on the
measurement of the higher harmonic components of the magnetic field of the
short circuit current-to-ground near the line, just as that of its predecessors,
the new design improves the fault detection reliability by reducing the
dependence of the readings of the portable meter on the distance between the
meter and the line conductors, as well as the dependence on the value of the
resistance in the short-circuit path. This is accomplished by using the unique
nature of the change in the magnetic and electrical field intensities when the
distance from the conductors is changed by means of incorporating in the
measured value of the magnetic field intensity a correction based on the
electrical field intensity. A block diagram of the instrument and schematic
are provided; the unit uses 10 transistors, 3 diodes and a magnetic sensor,
wound on a ferrite core. The test frequencies are 550 and 250 Hz. The
magnetic field sensitivity is no less than $1.5 \cdot 10^{-4}$ A/m at 550 Hz and $1.5 \cdot 10^{-3}$
A/m at 250 Hz; the sensitivity can be adjusted in steps in a range of 1:1 to
1:3,000. The operating temperature range is -40 to +40° C; the overall
dimensions are 230 x 85 x 95 mm and the meter weighs no more than 1.5 Kg.
Figures 2; references: 2 Russian.
[90-8225]

STUDY OF RADIO INTERFERENCE LEVELS PRODUCED BY AERODYNAMIC MOTION SUPPRESSORS
FOR POWER LINES

AZERNIKOVA, T. I., engineer and YEMEL'YANOV, N. P., candidate of technical
sciences, All-Union Scientific Research Institute of Electrical Power
Engineering (VNIIE)

[Abstract] Power-line conductors, especially for lines with split phases and
large cross-sections, can dance up and down with amplitudes reaching 5 - 6 m
and more. Protection against this is provided by plastic aerodynamic suppressors
installed on the lines at two or three points on each span. The suppressors
are made in the form of individual plates 1.5 m long with a comb-shaped pro-
jection 20 to 25 mm high for 220 KV and higher lines with conductors 22 to
23 mm in diameter. This paper examines the additional radio interference

produced by the corona discharge occasioned by such suppressors. The only
difficulty arise when metal fastening brackets are used to secure the plastic
suppressors to the lines. The majority of 110 KV and some 220 KV lines operate
at conductor surface field intensity levels which allow the retention of the
existing suppressor design, according to present interference norms. For
higher voltages though, the flat metal fastening brackets must be eliminated
and the question of changing the structural design of the fasteners reviewed
if conformance with the interference standards is to be maintained. Figures
3; references 7: 6 Russian, 1 Western.
[90-8225]

OPERATION OF 750 KV LINES WITH REDUCED NUMBER OF SHUNTING REACTORS

BELYAKOV, N. N., candidate of technical sciences, LOKHANINA, N. I., engineer,
and RASHKES, V. S., candidate of technical sciences, All-Union Scientific
Research Institute of Electrical Power Engineering (VNIIE)

[Abstract] The shunting reactors in ultrahigh voltage power grids serve to
balance the reactive power and the requisite working voltage under normal
conditions, and limit temporary overvoltages as well as switching overvoltages
during planned and emergency switching of the lines. Experience with starting
and operating 750 KV lines has revealed the practical necessity of using at
times a reduced number of shunting reactor groups and phases. Such operation
is based on allowing elevated reactive power drains into adjoining systems as
well as increased temporary overvoltages which are of limited duration.
Specific measures which allow for line operation of this type are: 1) A
particular programmed sequence for line connection; 2) Reduction of the
equivalent e.m.f. of the supply grid by 2 to 4%; 3) Semi-automatic planned
closure, in which, following the operational closure of the line from one end
to the other carried out automatically, synchronization is established and
the line is set for through-working after the absence of faults and the appear-
ance of the working voltage on the line are established. Measures are also
recommended for three phase disconnection of a 750 KV line with an asymmetrical
short-circuit following an unseccessful automatic reclosure attempt. The
specific requirements related to the lack of a shunting reactor phase are also
discussed in light of graphs showing the temporary overvoltages at the open end
of a 750 KV line with a single phase short-circuit at one end. It is possible
to operate such HV lines with three-fourths to one-half of the design number
of shunting reactors, and for lines 300 to 400 km long, the system can make
do without any reactors. These measures have made it possible to place a
525 km line in service with just two groups of reactors, and operate a 334 km
line with no reactors and a 546 km line with eight reactor phases. This in
turn speeds up the placing of lines in service and provides for their operation
with the failure of individual phases. Figures 1; tables 1; references:
3 Russian.
[90-8225]

HIGH PRESSURE 110 - 500 KV POWER CABLES

MAKIYENKO, G. P. and TYURIN, A. V., engineers, Kama Cable Plant Moskabel
Production Association

[Abstract] Since 1980, all types and sizes of oil-filled cables have been
manufactured in accordance with State Standard GOST 16441-78 "Alternating
Current 110 - 500 KV Oil-Filled Cables. Technical Specifications". This
specification covers the basic types of low and high pressure cables. The
two main types of high-pressure cables are: 1) MVDT - oil-filled, high-
pressure cable in a temporary lead jacket which is removed at the installation
site when the cable is pullsed into the conduit; and 2) $MVDT_k$ - oil-filled,
high-pressure cable in a container with oil. The physical specifications of
these cables are summarized in tabular form and drawings show the cross-section
through a high-pressure cable as well as the container for a cable without a
lead jacket and the equipment configuration at the installation site for
placing high pressure 250 KV cable into the steel conduit from the supply
container. Operational experience with high-pressure cables going back over
20 to 25 years shows that they provide excellent service and will be even
more widely used in the years ahead. Figures 5; tables 1; references:
4 Russian.
[90-8225]

PARAMETERS OF COMMUNICATIONS CHANNELS USING LIGHTNING PROTECTION CABLES OF
750 KV POWER LINES

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Institute of Power Systems and Electric Power Networks--All-Union Scientific
Research Institute of Electrical Power Engineering (Energoset'proyekt-VNIIE)

[Abstract] In order to prevent coronas, lightning protection cables on
ultrahigh voltage power transmission lines are designed as split separate
cables. This presents the opportunity of using the isolated conductors of
the split cable to set up communications channels. Because HF channels using
split cable lines will be the primary communications channels for the 1,150
KV power lines, this paper analyzes the experimentally obtained parameters of
such channels and provides a comparison with theory. The input impedance of
such a lightning protection cable channel using the isolated conductors of the
split cable for a 750 KV power line as well as the crosstalk attenuation
between such a channel and another channel using a phase-to-ground circuit

are also studied both experimentally and theoretically. The calculated cross-talk attenuation of the lightning cable channel to the phase-to-ground channel at the near end is about 60 dB; the measured values averaged 10 dB less. The measurement circuit configurations are shown and the attenuation of the lightning cable channel is graphed as a function of frequency between about 20 and 500 KHz, shown a maximum of 0.25 dB/km at 500 KHz; the far end crosstalk attenuation from the lightning cable channel to the phase-ground channel is also graphed as a function of frequency between about 30 and 300 KHz. Generally good agreement is noted between the calculated and measured values. There are three periodically repeating inhomogeneities in the lightning cable channel: Those due to the insulating spreaders, the insulator strings and the capacitance of the split cable conductors to the supports. The lightning cable channel exhibits a range of resonant frequencies in which an attenuation maximum is observed caused by the shunting effect of the leakage impedance of the cable insulator strings and the capacitance of the split cable conductors to the supports. Figures 5; references: 4 Russian.
[90-8225]

FREQUENCY SENSITIVE RELAY USING DIGITAL TECHNOLOGY

SIVOKOBYLENKO, V. F., candidate of technical sciences and FIL', M. I., engineer, Donetsk Polytechnical Institute

[Abstract] Present frequency sensitive relays such as the IVCh-3 and RCh-1 which are widely used in power system control and automation systems suffer from the drawbacks of having an actuation frequency which is dependent on the level of the voltage being monitored as well as poor stability of the actuation frequency. The design of a digital frequency relay is described: the supply voltage is 220 V at a current of 1 A; the monitored voltage range is 10 to 150 V, the working frequency range is 27.5 to 55 Hz, and can be set between 36 and 55 Hz; the discrete frequency steps are 0.025 Hz each; the maximum difference between the actuation and reset frequencies is 0.005 Hz, while the temperature stability of the actuation threshold is 0.000112 Hz/deg. A prototype of this digital frequency sensitive relay has been in trial operation in the Donbass Power System and its performance has been excellent. Figures 3; tables 1; references: 4 Russian.
[90-8225]

PIEZOELECTRIC LIGHT MODULATOR

ADRIANOVA, I. I., ZASLAVSKAYA, V. R., SMIRNOV, V. A., TAKTAROV, S. G. and
CHERKALINA, N. F.

[Abstract] A piezoelectric ceramic light modulator can be constructed using
a stack of piezoelectric plates connected in series mechanically and in
parallel electrically. Such stacks or columns are used in laser beam control
devices such as those for tuning a laser resonator or scanning interferometer.
One such modulator was built from 13 discs made of TsTS-19 ceramic material
15 mm in diameter and 0.3 mm thick. The end of the column has an adhesive
attached mirror with a reflective coating for a wavelength of 0.633 micro-
meters. In a frequency range of 5 to 30 KHz with control voltages of 70 to
100 volts, a phase deviation amplitude for optical radiation at 0.633 micro-
meters of 2-Pi radians was achieved. A very narrow resonance is observed in
the region of 20 KHz, which has an insignificant impact on modulator operation.
The amplitude response of the modulator is plotted in the form of graphs
showing displacement as a function of control voltage; a displacement of
approximately 0.5 micrometers is obtained at control voltages of around 80
volts. Figures 3; references 4: 3 Russian, 1 Western in translation.
[93-8225]

TEMPERATURE STUDIES OF ELECTRO-OPTICAL SHUTTER BASED ON PLZT CERAMIC MATERIAL

KAZANTSEVA, N. N. and SOSENSKIY, A. M.

[Abstract] Lead-lanthanum zirconate-titanate (PLZT) ceramic samples 0.25 mm
thick having a volatile transmittance state were used as optical shutters in
order to determine the contrast coefficient and the half-wave voltage as a

function of temperature in a range of -40° to +70° C. Because the contrast
of the ceramic material changes greatly over its cross-section, the samples
were annealed at 700°C for 20 minutes and then cooled to room temperature for
6 to 7 hours. This equalized the contrast over the cross-section in a range
of 2,000 to 11,000. The experimental configuration of the laser light source,
the test cell and the photomultiplier circuitry is shown, as well as graphs
of the half-wave voltage as a function of the contrast coefficient and tempera-
ture, the shutter transmittance when a control voltage is applied for tempera-
tures of +20, -40 and +70°C, and the shutter contrast as a function of the
repetition rate of the control pulses at between 0 to 90 Hz. PLZT 9/65/35
ceramic makes it possible to construct a shutter with a contrast coefficient
of 10^4. The shutter speed in the indicated temperature range is practically
independent of the temperature, while the contrast coefficient falls off
sharply in the low temperature range; the half-wave voltage increases at
temperatures above +50° C and below 0° C. Figures 4; references 11:
6 Russian, 5 Western.
[93-8225]

COUPLING DEVICE FOR JOINING SINGLE MODE FIBER OPTIC LIGHTGUIDES TO
SEMICONDUCTOR LASERS

AYUNTS, Yu. Kh., BELOVOLOV, M. I., DIANOV, Ye. M., FILIMONOV, V. P. and
TSIBULYA, A. B.

[Abstract] Because semiconductor single mode channel lasers are more
convenient for use in communications equipment in order to bring the output
of lasers into single mode fiber optics, an appropriate mechanical coupling
device has been developed. The unit employs an adjustment head providing an
adjustment precision of about 0.1 micrometers in three dimensions. A
schematic drawing and photograph of the device are provided and used to
describe briefly the set-up and adjustment of the mechanism. The range of
transverse adjustments of the laser holding head is 0.3 mm with the use of
the vernier adjustment screws, while the initial coarse adjustments are made
by moving the support stage. The initial matching of the end face of the
fiber optic lightguide to the radiating surface of the laser is monitored
visually using a microscope, while the fine adjustment is made using a signal
from a photodetector to which the other end of the lightguide is coupled. A
provision is also made for permanently connecting the laser to the lightguide.
The energy coupling efficiency runs to several tens of percent. Figures 3;
references: 3 Russian.
[93-8225]

SONICS AND ULTRASONICS

BRAGG ACOUSTICOOPTICAL INTERACTION IN CRYSTALLINE MEDIA

ZADORIN, A. S., Tomsk Institute of Automated Control and Radio Electronics
Systems

[Abstract] The self-similar problem of Bragg diffraction of a planar light
wave on a flat elastic wave in optically anisotropic media is extended to
crystals of an arbitrary class of symmetry. Equations are derived for the
amplitudes and intensities, and the influence of deviation of both light and
acoustical waves from the wave normals on the effectiveness and frequency
band of the interaction is determined. Figure 1; references 9: 8 Russian,
1 Western.
[222-6508]

CONTROLLING THE ANGULAR DIVERGENCE AND SPATIAL POSITION OF RADIATED BEAM

PLESHANOV, Yu. V., CHISTYAKOV, S. N. and STARIKOVSKIY, O. N.

[Abstract] Telescopic systems in conjunction with various kinds of deflecting devices are usually employed to control the angular divergence of output beams and their position in space. However, it is possible to accomplish this using a simple Galilean telescope without any additional optical components. Such a telescope can realize circular scanning of the beam, where the negative optical element is shifted perpendicularly to the optical axis and is mounted taking into account the capability of rotating about the optical axis of the system. This ability to control both angular divergence and deflection can be realized by shifting the negative component relative to two mutually perpendicular axes, where one of them corresponds to the optical axis of the system. A specific optical device is shown schematically: the visual magnification is one-seventh; the focal distance of the first lens is -56.72 mm and that of the second is 396.59 mm; the amount of displacement of the first optical component along the optical axis is 12 mm and the component is shifted through an angle of 2°30! relative to the optical axis in this case. The beam divergence is increased by approximately a factor of six at the system output. An electric motor is used to drive the moving lens. It is also possible to vary separately the axial shift of the telescopic system component and its eccentricity (though not in the system built as described above), which makes it possible to change the angular divergence of the beam and the amount of deflection independently of each other when necessary. Figures 1; references: 6 Russian.
[93-8225]

ANALYSIS OF INFLUENCE OF ANNULAR SHADING OF ENTRANCE PUPIL OF OPTICAL SYSTEM ON IMAGE QUALITY

GAN, M. A., OBRAZTSOV, V. S. and SITNIK, N. A.

[Abstract] The effort to circumvent mechanical and temperature stability problems associated with monolithic large diameter telescope objectives by means of aperture synthesis has led to the consideration of optimal configurations for filling the entrance pupil by the individual optical components. A promising approach is the use of a set of concentric ring apertures to fill the entrance and control the energy distribution in the point scattering function as well as the shape of the frequency-contrast characteristic. This paper determines the indicators of image quality provided by optical systems using such annular shielding. Two variants are analyzed: 1) The entrance pupil takes the form of four concentric aperture rings of equal width where the radii of the openings are 1/4 R, 1/2 R, 3/4 R and R, while the width of the openings is 0.2 R; and 2) The ring openings are of different widths: the width is $a_n = an$, $a = 5.25 \cdot 10^{-2}$, where n = 1, 2, 3, 4 is the ordinal number of the aperture, starting from the entrance pupil. The following were calculated: 1) The fraction of the total energy as a function of the radius of the scattering disc, q, in the diffraction pattern for a point object; 2) The point scattering function; and 3) The frequency-contrast characteristic. The results are compared graphically and show that the two annular shielding cases are clearly superior to a center blocking disc and reduce the level of the first sidelobe maximum of the point scattering function by an order of magnitude and simultaneously increase the value of the integral energy within the bounds of the Airy disc. This allows for an improvement in optical system resolution when observing two point targets of greatly differing brightness. Annular shielding produces greater suppression of the lower spatial frequencies than does a center disc and increases the transmittance of the center frequencies. The results enable the selection of the form of the entrance pupil of composite objectives. Tables 1; figures 1; references 9: 5 Russian, 4 Western.
[93-8225]

ORGANIZING PARALLEL COMPUTATION IN SOLVING NONLINEAR FIELD THEORY PROBLEMS ON GRIDS

PROKOF'YEV, V. Ye. and DENISENKO, T. A.

[Abstract] A study is made of discrete-analog grid processors, a new class of mathematical grid machines designed to solve linear and nonlinear parabolic

equations in partial derivatives. It is shown that the methodologic error
of such a processor can be virtually eliminated by symmetrical placement of
control pulses relative to each other. The operation of a discrete-analog
RC network which uses the method of direct finite-difference operators to
implement a univariate heat conductivity equation is studied. Balancing the
pulses is found to decrease error by a factor of almost 100. When the number
of grid nodes is increased the time constant of each element is decreased by
the square of the number of nodes, causing an increase in error. Digital
devices have been designed to implement discrete-analog computing structures.
Figures 5; references 14: 13 Russian, 1 Western in translation.
[219-6508]

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